SATF 2016

Science and Applications of Thin Films, Conference & Exhibition

September 19 to 23, 2016

Ilica Hotel Spa & Wellness Thermal Resort,

Cesme, Izmir, Turkey

www.satf2016.org

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Preface

On behalf of the Conference Committee, I would like to warmly welcome to everyone participating to the *"Science and Applications of Thin Films, Conference & Exhibition (SATF 2016)"* being held in Ilica Hotel Spa & Wellness Thermal Resort, Çeşme, Izmir, Turkey, from September 19 to 23, 2016.

The first series of the conference, SATF 2014, was held at the Altin Yunus Resort & Thermal Hotel, Cesme, Izmir, Turkey, from September 15 to 19, 2014. SATF 2014 constituted a valuable platform for individuals to present their research findings, display their work in progress and discuss conceptual advances in many different branches of thin films. It was a very successful conference with over 450 abstracts submitted from 44 countries, of which 30 were invited talks, and the rest distributed between 103 contributed talks and over 250 poster presentations. Based on refereed evaluation of all the papers submitted, about 40 papers were selected for publication in Vacuum and Applied Surface Science.

SATF 2016 will focus on various topics related to Thin Films and novel phenomena in Thin Film science and applications. The conference is intended to provide an opportunity to bring prominent scientists together from various countries, with a common objective to exchange information and ideas, to promote stimulus discussions and collaborations among participants and furthermore to foster young scientists.

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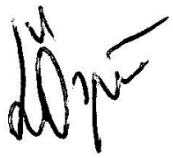
Additionally, Izmir hosts a large number of extremely important architectural and cultural sites. The town is nicknamed as the Pearl of the Aegean and Cesme in İzmir is surrounded by the Aegean Sea in three sides at the very western end of Urla Peninsula and is neighbor of the Sakiz (Chios) Island. My wish is that you will all join us for a symphony of outstanding science, and take a little extra time to enjoy the unique beauty of Çeşme and its surroundings.

Finally, we want to express our special gratitude to all the participants, and we would also like to thank our colleagues in the Conference Committee, whose commitment enabled us to achieve our goal. In the spirit and tradition of Turkish hospitality, we once more welcome you all to SATF 2016, I would like to wish you a nice and enjoyable stay in the Çeşme, may you all return home feeling recharged and ready to continue the invaluable explorations.

Best regards,



Lutfi Ozyuzer
Chair

Scope of the SATF 2016 Conference & Exhibition

The SATF 2016 international conference will focus on various topics related to Thin Films and novel phenomena in Thin Film science and applications.

More specifically,

- Science of Thin Films and Quantum Effects
- Theory of Structure, Surface and Interface
- Thin Film Growth & Epitaxy
- Nanostructured Growth
- Optical, Optoelectronic and Dielectric Coatings
- Organic Thin Films
- Thin Films in Biology
- Superconducting Thin Films
- Thin Films in Photovoltaic Cells and Energy
- Metallurgical Coatings
- Applications of Electrochemical and Electroless Depositions
- Advances in Deposition Techniques
- Characterization and Instrumentation
- Large Scale Coating and Industry

International Organizing Committee

International Steering Committee

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Deepak Kumar Basa	Utkal Univ., INDIA
Kamil Kosiel	Institute of Electron Technology, POLAND
John L. Reno	Sandia National Laboratories, USA
Mehtap Ozdemir	Teknoma Inc., TURKEY

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Lutfi Ozyuzer (Chair)	IZTECH, TURKEY
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Koray Sevim	IZTECH, TURKEY
Enver Tarhan	IZTECH, TURKEY

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Orhan Ozturk	IZTECH, TURKEY
Mauro Pereira	Sheffield Hallam University, Sheffield, UK
Lothar Pfitzner	Fraunhofer Inst. for Integrated Systems & Device Tech., GERMANY
Jochen M. Schneider	Aachen University, GERMANY

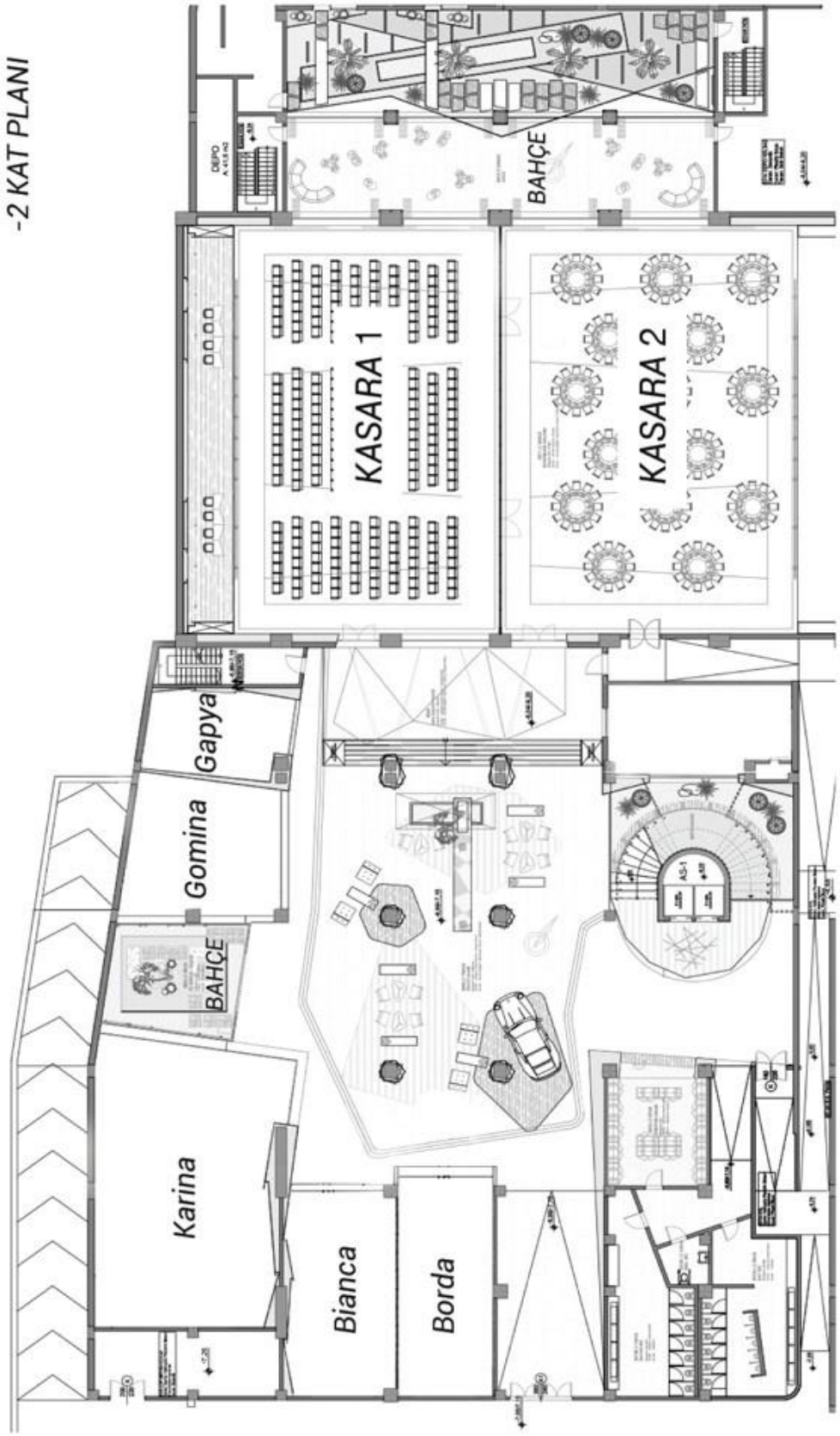
Yusuf Selamet	IZTECH, TURKEY
Yilmaz Simsek	Argonne National Lab., USA
Yoshihiko Takano	NIMS, JAPAN
Enver Tarhan	IZTECH, TURKEY
Rasit Turan	Middle East Technical Univ., TURKEY
Seniz Turkoz	Şişecam, TURKEY
Eyyuphan Yakinci	İnonu Univ., TURKEY
Fikret Yildiz	Gebze Technical University, TURKEY

Supporting Students

Hakan Alaboz	IZTECH, TURKEY
Gulsah Akca	IZTECH, TURKEY
Dilara Buldu	IZTECH, TURKEY
Ayten Cantas	IZTECH, TURKEY
Yasemin Demirhan	IZTECH, TURKEY
Ece Meriç	IZTECH, TURKEY
Hasan Koseoglu	IZTECH, TURKEY
Fulya Turkoglu	IZTECH, TURKEY
Seda Ulusoy	IZTECH, TURKEY
Hurriyet Yuce	IZTECH, TURKEY

Ilica Hotel Spa & Wellness Thermal Resort

Map



CONFERENCE PROGRAM

	Sept. 19, Monday
8:45-9:00	
9:00-9:30	
09:30-10:00	
10:00-10:20	
10:20-10:40	
10:40-11:10	
11:10-11:40	
11:40-12:00	
12:00-12:20	
12:20-12:40	
12:40-14:00	LUNCH
14:00-14:30	Registration
14:30-14:50	Registration
14:50-15:10	Registration
15:10-15:30	Registration
15:30-15:50	Registration
15:50-16:10	Registration
16:10-17:30	Registration
17:30-18:00	Registration
	Registration
19:30-20:30	DINNER

	Sept. 20, Tuesday Kasara 1	**Sept. 20, Tuesday Kasara 2**
	SC: Lutfi Ozyuzer	
8:45-9:00	Opening Ceremony **Prof. Lutfi Ozyuzer** SATF2016 Chairman **Prof. Mustafa Guden** Rector of IZTECH	
9:00-9:30	**IS01: K. Kadowaki**	
09:30-10:00	**IS02: M. Sahiner**	
10:00-10:20	**CT01: W. Nawrocki**	
10:20-10:40	**CT02: P. Badica**	
10:40-11:10	COFFEE BREAK	COFFEE BREAK
11:10-11:40	SC: W. Nawrocki	SC: G. Karapetrov
	IS03: B. Basim	**IS04: A. Oral**
11:40-12:00	**CT03 H. Brown**	**CT06: G. Aygun**
12:00-12:20	**CT04: N. Matsunami**	**CT07: M. Baker**
12:20-12:40	**CT05: A. Uygun Oksuz**	**CT08: M. Ozdemir**
12:40-14:00	LUNCH	LUNCH
14:00-14:30	SC: B. Basım	SC: A. Oral
	IS05: A. Bek	**IS06: O Tuna**
14:30-14:50	**CT09: T. Kamas**	**CT12: H. Efeoglu**
14:50-15:10	**CT10: F. Kurdesau**	**CT13: D. Mansuroglu**
15:10-15:30	**CT11: M. Weidner**	
15:30-15:50	COFFEE BREAK	
15:50-16:10	SC. M. Ozdemir **Şişecam Special Session** Prof. S. Oktik, Dr. Erdem Arpat, Dr. Aref Cevahir, Dr.Tuncay Turutoglu, Gulsah Kahraman	
16:10-17:30		
17:30-18:00		
19:30-20:30	DINNER	DINNER

	Sept. 21, Wednesday Kasara 1	Sept. 21, Wednesday Kasara 2
	SC: P. Badica	SC: G. Aygun
9:00-9:30	**IS07: G. Karapetrov**	**IS09: S. Oktik**
09:30-10:00	**IS08: N. Miyakawa**	**IS10: A. Demir**
10:00-10:20	**CT15: M. Afak**	**CT17: T. Gungor**
10:20-10:40	**CT16: A. M. Samoylov**	**CT18: S. S. Ugur**
10:40-11:10	COFFEE BREAK	COFFEE BREAK
11:10-11:40	SC: H. Efeoglu	SC: M. Sahiner
	IS11: K. Nakajima	**IS12: A. Yamashita**
11:40-12:00	**CT19: D. Kaya**	**CT22: M. Ozpirin**
12:00-12:20	**CT20: T. Çakici**	**CT23: N. Yagmurcukardes**
12:20-12:40	**CT21: B. İkizler**	**CT24: S. Japarpour**
12:40-14:00	LUNCH	LUNCH
14:00-14:30	SC: M. Mutlu	SC: K. Kadowaki
	IS13: U. Unal	**IS14: A. K. Okyay**
14:30-14:50	**CT25: H. Algul**	**CT29: E. Gungor**
14:50-15:10	**CT26: T. Hadjersi**	**CT30: H. Yuce**
15:10-15:30	**CT27: T. Iwayama**	**CT31: L. Arda**
15:30-15:50	**CT28: G. Kabay**	**CT32: E. Abacioglu**
15:50-16:10	COFFEE BREAK & POSTER SESSION A	
16:10-17:30		
17:30-18:00	COFFEE BREAK & POSTER SESSION A	
19:30-20:30		
20:30-21:30	**Gala Dinner & Turkish Night**	**Gala Dinner & Turkish Night**
21:30-22:30	**Gala Dinner & Turkish Night**	**Gala Dinner & Turkish Night**
22:30-23:30	**Gala Dinner & Turkish Night**	**Gala Dinner & Turkish Night**

	Sept. 22, Thursday Kasara 1	Sept. 22, Thursday Kasara 2
	SC: N. Miyakawa	SC: U. Ünal
9:00-9:30	**IS15: A. Hoffmann**	**IS17: A. Schüler**
09:30-10:00	**IS16: S. Shayestehaminzadeh**	**IS18: A. Hassan**
10:00-10:20	**CT33: E. Ozceri**	**CT35: O. Arı**
10:20-10:40	**CT34: M. Tokur**	**CT36: D. Bouhafs**
10:40-11:10	COFFEE BREAK	COFFEE BREAK
11:10-11:40	SC: K. Nakajima	SC: A. Hoffman
	IS19: I. Kakeya	**IS20: R. Webb**
11:40-12:00	**CT37: C. Sabah**	**CT40: A. Turos**
12:00-12:20	**CT38: S. Ozcan**	**CT41: M. A. Olgar**
12:20-12:40	**CT39: H. Ben Temam**	
12:40-14:00	LUNCH	LUNCH
14:00-14:30	SC: A. Ekicibil	SC: A. Uygun
	CT43: G. Ozkazanç	**CT47: B. Kutlu**
14:30-14:50	**CT44: F. Turkoglu**	**CT48: T. Tansel**
14:50-15:10	**CT45: A. Cantaş**	**CT49: E. Sarıca**
15:10-15:30	**CT46: G. Birant**	**CT50: N. Akçay**
15:30-15:50		
15:50-16:10	COFFEE BREAK & POSTER SESSION B	
16:10-17:30		
17:30-18:00	COFFEE BREAK & POSTER SESSION B	
19:30-20:30	DINNER	DINNER

	Sept. 23, Friday Kasara 1	Sept. 23, Friday Kasara 2
	SC: I. Kakeya	
9:00-9:30	**CT51: L. Ozyuzer**	
09:30-10:00	**IS21: H. Altan**	
10:00-10:20	**CT52: E. Yildirim**	
10:20-10:40	**CT53: C. Sabah**	
10:40-11:10	COFFEE BREAK	
11:10-11:40	SC: H. Altan	
	IS22: C. Otani	
11:40-12:00	**CT54: Y. Demirhan**	
12:00-12:20	**CT55: G. Aral**	
12:20-12:40		
12:40-14:00	LUNCH	LUNCH
14:00-14:30	SC: C. Sabah	SOCIAL PROGRAM
	CT56: H. Koseoglu	
14:30-14:50	**CT57: H. Alaboz**	
14:50-15:10	**CT58: M. Yıldırım**	
15:10-15:30	**Concluding Remarks**	
15:30-15:50		
15:50-16:10		
16:10-17:30		
17:30-18:00		

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POSTER SESSION A (3.30 pm to 6.00 pm, September 21, 2016)

PA001	**Anodic Formation of Nanoporous Crystalline Niobium Oxide** Leonid SKATKOV
PA002	**Surface Coverage Control of Self Organized Plasmonic Interfaces for Photovoltaics** Gizem BIRANT
PA003	**Surface Enhanced Raman Scattering Activity of 0 and 1 Dimensional Silver Nanostructures** Ozge DEMIRTAS
PA004	**Microstructure and Corrosion Behaviour Of AISI 4140 Steel Modified By Pulse Plasma Treatment** Yıldız YARALI OZBEK
PA005	**Magnetic properties of thin film and superlattices** Rachid Masrour
PA006	**Electrical properties of p-n diodes based on undoped and Iodine doped ZnO nanorods prepared by hydrothermal method** Hadjersi Toufik
PA007	**Pulse electrodeposition of nickel-titanium nitride composite coatings** Muhammet KARTAL
PA008	**Kinetics of tartrazine photodegradation by Cu modified silicon nanowires** Sabrina NAAMA
PA009	**Characterization of CdS Thin Films Grown by Chemical Bath Deposition Using Two Different Cadmium Salts** Hassiba MOUALKIA
PA010	**Effect of Gum Arabic on Hydrogen Evolution of Ni/Mo Electrodes Prepared by Electrodeposition Route** Elhachmi GUETTAF TEMAM
PA011	**Determination of the Refractive Index of Dielectric Films from the Transmittance Spectrum by Using Morse Wavelet** Erhan TIRYAKI
PA012	**An Improved Method For Simultaneous Determination Of Refractive Index And Thickness Of Dielectric Films: A Simulation Study** Seckin OZCAN
PA013	**Aluminum doped amorphous silicon carbide by co-sputtering DC magnetron** Amer BRIGHET
PA014	**Development of Three-Dimensional Nanomorphologies in Carbon Thin Films** Ronaldo MANSANO
PA015	**Thermal Effect on I-V Properties for GaAs MESFET transistors** Chahrazed KADDOUR

PA016	**Influence of Deposition Parameters on ZnO:Ga Thin Films** Nilufer DUYGULU
PA017	**Influence of some reactive elements addition on the microstructural, mechanical and tribological properties of niobium carbide coatings** Eray ABAKAY
PA018	**Effect of Bilayer Period on the Properties of Mo2N/CrN Multilayer Coatings Produced by R.F Magnetron Discharge** Boudjemaa BOUAOUINA
PA019	**Optical, microstructural and photocatalytic properties of metals doped TiO2 thin films** Fayçal BENSOUICI
PA020	**Optoelectronic Properties of Nanostructured Carbon Thin Films by High Density Plasma Chemical Vapor Deposition** Ronaldo MANSANO
PA021	**Electrical and Photoelectrical Properties of (Poly(divinylbenzene)/ Multi-Walled Carbon Nanotube Nanocomposite)/n-Si Diodes** Banu KUCUR
PA022	**Structural analysis of Ge nanoparticles embedded ZnO thin films by Laser Induced Breakdown Spectroscopy (LIBS)** Kemal Efe ESELLER
PA024	**Structural and optical properties of transparent Y-doped anatase TiO2 thin films grown by Nd-YAG laser annealing** Faouzi HANINI
PA025	**Effect of plasma oscillation on the ion deposition distribution in the process of an electron beam-heating metal substrate** C. Y. HO
PA026	**Effect of Al doping on the structural and optical properties of SnO2 thin films elaborated by sol-gel technique** Mourad KHECHBA
PA027	**Studies in Cu2ZnSnS4 based solar cells with various buffer layers** Abdesslam BOULOUFA
PA028	**Comparative Study of ZnO Thin Films Deposited by Spray Pyrolysis and Sol-Gel Technique** Malika MEDJALDI
PA029	**Numerical simulation of bias-illumination stress with equivalent oxide thickness effects of gate insulator on amorphous indium-tin-zinc-oxide thin film transistors (a-ITZO TFTs)** Takieddine TAOURIRIT
PA030	**Using Self Assembled Monolayer to Improve Device Performance of Organic Light Emitting Diodes** **Ahmet Nuri OZCIVAN**
PA031	**The Effect of Fluorine Doping On Structural, Electrical and Optical Properties of SnO2 Thin Films** Yasmina BENCHEIKH

PA032	**Fabrication of Cobalt Nanoparticles on Porous Silicon for Improved Photoluminescence** Alper CETINEL
PA033	**In situ photoelectron spectroscopy of WO3/LiPON interface for electrochromic devices** Olivia BOUVARD
PA034	**Effect of Si doping on the transition temperature and electronic properties of VO2 thin films** Anna KRAMMER
PA035	**Temperature Dependent Electrical Conductivity Behaviour of Sol-Gel Prepared Co:ZnO Thin Films** Ebru GUNGOR
PA036	**Tribological Properties at Room and High Temperature Conditions of TiVZrN Graded Composite Coatings Deposited with CFUBMS** Ozlem BARAN
PA037	**Plasmonic Effect on the Performance of Si-Based ZnSe Heterojunction** Seda KAYRA GÜLLÜ
PA038	**Device Characterization of Cu-Ag-Ga-Te Thin Films for Photovoltaic Applications** Hasan Hüseyin GÜLLÜ
PA039	**Dielectric Relaxation Mechanisms in CuO/Ball Type Phthalocyanine Composite Thin Films** Banu Süngü Mısırlıoğlu
PA040	**Optical and structural characterization of CuxZn1-x thin films deposited by thermal evaporation** Damla BULUT
PA041	**Studying the CdTe based extremely thin absorber layer solar cell** Arezoo HOSSEINI
PA042	**The vibration dynamics of the ordred bimetallic Pt(110)Cu(110)/Pt surface alloys** Fazia LEKADIR
PA043	**The superconductivity in Mg-doped InN grown by Molecular Beam Epitaxy** Ahmet EKICIBIL
PA044	**Determination of longitudinal optical phonon energy of GaAs1-xBix quantum wells (QWs) grown on various orientations by MBE** Mustafa AKYOL
PA045	**Study on the Performance of AlInP/n-InGaP/p-InGaP/AlGaInP Top Cell In Triple Junction Solar Cell** Meryem LASLADJ
PA046	**Parameters Extraction of Solar Cell Based on p-Si/n-Zno:Al Structure Using Genetic Algorithm** Safia KEREOR

PA047	**Characterization of thin-film $Li_{0.5}La_{0.5}Ti_{1-x}Al_xO_3$ Electrolyte for all solid state Li-ion batteries** Seda Ulusoy
PA048	**Spectral response of porous thin hydrogenated amorphous silicon carbide films (a-Si0.7C0.3:H)** Assia BOUKEZZATA
PA049	**Production of Au-Ag Thin Films and Investigation of Some XRD and XRF Parameters** **Omer SOGUT**
PA050	**Morphological Characterization of Zinc Oxide Nanomaterials and Their Applications in Dye Sensitized Solar Cells** Sule ERTEN ELA
PA051	**Polyvinyl chloride-co-Activated carbon nanoparticles nanocomposite electrodialysis cation exchange membranes: Fabrication and characterization in desalination process** Sayed M. HOSSEINI
PA052	**Influence of Al co-doping on the structural, optical, and electrical properties of Cu-doped ZnO thin films** Abdullah YILDIZ
PA053	**Growth of large area, single- and few-layer graphene on Ni-Cr by CVD method** Mostafa DADASHBABA
PA054	**Decolouration of Orange II solutions by the active layers of Cu-doped ZnO deposited on ceramics based on mullite and zircon** Bouras DIKRA
PA055	**Nitrogen Doping of Graphene by Plasma Treatment** Alper YANILMAZ
PA056	**Design and Device Application of Si-Based Cu-Ag-Ga-Te Thin Film Heterostructure** Hasan Huseyin GULLU
PA057	**Fabrication and Characterization of Ag-TiO2-NTs and Investigated Carrier Density in I^- /$I3^-$ Electrolyte by Electrochemical Impedance Spectroscopy** Birgul YAZICI
PA058	**Preparation of Poly(3-Hexylthiophene) Sensitized Ag Doped TiO2-NTs and Its Carrier Density Determined by Mott–Schottky Analysis** Evrim BARAN
PA059	**Fabrication, characterization and modelling of n-ZnO /p-Si solar cells** Nikolay CHUCHVAGA
PA060	**The influence of electric field applied during depositon on functionality of TiO2/VO2 thin films** Nursel CAN
PA061	**Production of antibacterial polymeric coatings from essential oils** Bayram OZKAN

PA062	**Betavoltaic study on GaN p-i-n diode with Ni-63 source** Neslihan AYARCI
PA063	**Determination of Contact Parameters of Al/p–Ge Diode with Methyl Green Interlayer** Fikriye Seyma OZCELIK
PA064	**Investigation of Annealing Effects on Optical Properties of CuO Thin Films Deposited by SILAR Method** Yunus AKALTUN
PA065	**Synthesis, Characterization and Modelling of ZnSe/Zn(Cd)S/Cd(Zn)S and CdSe/Zn(Cd)S/Cd(Zn)S Core/Shell/Shell Nanocrystals** Hadi S. PISHEH
PA066	**Produced to transition metal doped, Dy: ZnO and Dy: MgO thin fims by Chemical Spray Pyrolysis method and investigation to the thin films structures** Tuba CAKICI
PA067	**Microstructure and Mechanical Behaviour of Aluminium Oxide Thin Films** Younes BENARIOUA
PA068	**Dopant Concentration Effects on Mn-Doped ZnO Thin Films** Reza Sahraei
PA069	**Tailored Protein Adsorption on Biocompatible Plasma Nanofilms** Fethi Olcaytuğ
PA070	**Synergistic Tungsten Oxide/Conducting Polymer Hybrid Nanofiber Assemblies for Highly Efficient Electrochromic Devices** Aysegul Uygun Oksuz
PA071	**Electrochemical Preparation of Poly(2-chloroaniline) and poly(aniline-co-2-chloroaniline)Modified ZnFe Films on Carbon Steel Surface and Their Corrosion Performance** Adurrahman Akdağ
PA072	**Interface Analysis of HfO2 Thin Film Grown on Si by RF Magnetron Sputtering Technique** A. Cantas
PA073	**Fabrication of Cu2ZnSnS4 Absorber Layer on Flexible Titanium Foil Substrate for Thin Film Solar Cell Applications** Dilara G. Buldu

POSTER SESSION B (3.30 pm to 6.00 pm, September 22, 2016)

PB001	**Enhancement Of High-Carbon Steel Surface Properties Through Pulse Plasma Technique** Yıldız YARALI OZBEK
PB002	**Theoretical Determination of the Refractive Index and Extinction Coefficient of an Absorbing Thin Film by Using Morse Wavelet** Erhan TIRYAKI
PB003	**Nanostructured Diamond-like Carbon Thin Films Growth on Stainless Steel** Ronaldo MANSANO
PB004	**Electro- optical characterization of amorphous niobium oxide deposited by RF magnetron sputtering** Ronaldo MANSANO
PB005	**Investigation of Material Properties of Magnetron Sputtered Cu-Ag-In-Se Thin Films** Hasan Huseyin GULLU
PB006	**Phthalocyanine as a Sensitive Material for Organic Vapour Detection using Acoustic Wave Based Sensors** Amani HAMID
PB007	**Effect of hydrogenation on defect density and electrical properties of CdTe** Baris AKBALI
PB008	**Molecular Beam Epitaxial Growth of ZnSe on (211)B GaAs** Begum YAVAS
PB009	**Characterization of Metal(Ag, Au)/Pc thin film/Semiconductor Structures by Impedance Spectroscopy Technique** Cigdem ORUC
PB010	**An investigation on characterization of ZnO/p-GaAs structure synthesized by sol-gel technique** Fikriye Seyma OZCELIK
PB011	**Investigation of Thermally Grown Oxide (TGO) Growth Behaviors of Single and Double Layered Rare Earth Zirconates under Isothermal Oxidation Conditions** Kadir Mert DOLEKER
PB012	**Comparison of Hot Corrosion Behavior of YSZ and YSZ/La2Zr2O7 Double Layer Thermal Barrier Coatings (TBCs) Exposed to Na2SO4 and V2O5 Salts** Yasin OZGURLUK
PB013	**Dielectric and Electrical Properties of lead-free Bi0.5Na0.5TiO3 : BaTiO3 (BNT-BT) Ferroelectric Thin Films by Pulse Laser Deposition** J. S. KIM

PB014	**Dimethylamine Borane Oxidation At Metal Nanoparticles Modified Composite Polymer Electrode** Cagri Ceylan KOCAK
PB015	**Tribological and Corrosion behavior of Cu/Al2O3/Graphene Hybrid Nanocomposites Produced by Electroless Coating** Mehmet UYSAL
PB016	**Characterization of K and Mg Co-Doped BST Thin Films with SrTiO3 Buffer Layers in Cross-Over Concentration Design** Sizhe WANG
PB017	**Spectroscopic Study of Film Formation From PS Latex/AgNPs Composites** Emre KUCUKKAHVECI
PB018	**Nanostructural and Optical Properties of TiO2 Films Grown By Reactive RF Magnetron Sputtering as a Function of Oxygen Flow Rate** Alireza GRAYELI KORPI
PB019	**In-situ MgB2 thin film fabrication on commercial Ni- tapes by e-beam evaporation and their electrical performance** Emine ALTIN
PB020	**Numerical simulation of the a-Si:H/µc-Si:H tandem solar cell performance sensitivity to the µc-Si:H tunnel junction dopant concentrations and thickness** Mohamed Nadjib KATEB
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IS01

Coherent Terahertz Electromagnetic Wave Emitters Using High Temperature Superconducting $Bi_2Sr_2CaCu_2O_{8+\delta}$ IJJs: Recent Advances and a Comparative Study

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[keywords] Intrinsic Josephson Junctions, terahertz waves.

In 2007, powerful THz electromagnetic waves was discovered by us from a mesa structure made of intrinsic Josephson junctions, which consist of natural stacks of Josephson junctions in $Bi_2Sr_2CaCu_2O_{8+\square}$ (Bi2212) single crystals, when the synchronization is established in between superconducting layers[1-2] by simply applying dc voltage. After intensive studies since then, it is possible to make a reliable THz wave emitter by improving thermal conduction between the device surface and the thermal bath[3-5]. Although the mechanism of synchronization is not fully understood yet[6], the power of 625 □W so far has successfully been obtained in an array of three mesas[7]. In addition, the maximum frequency of 2.4 THz has so far been observed. The more power and the wider frequency spectra may be desirable for possible applications[8-13].

We will describe the recent experimental results on the stand-alone mesa and will show in detail the way of assembling of the device. Some applications obtained by using the IJJ THz emitters are also shown at the conference.

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IS02

Semiconductor Thin Film Synthesis and Characterization by Synchrotron Based Spectroscopy

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Material based problems of semiconductor thin films can best be resolved with the detailed structural information and the correlation between the introduced subtle structural changes and device performance. The need of highly sensitive structural probing techniques has increased dramatically with the continuous downscaling the semiconductor devices to improve electrical performance. Due to scaling-related new emerging based problems, new or structurally modified materials will have to be used in crucial parts of the future complimentary metal-oxide semiconductor (CMOS) devices. Synchrotron radiation based spectroscopies can provide the crucial information to correlate the local structural modifications introduced by to new materials or variations in the synthesis conditions. In this talk, recent examples of synthesis conditions versus structure variations as probed by x-ray absorption spectroscopy in thin films of CMOS devices will be presented. Selected examples will be on 1-) Hf based gate dielectrics where Al diffusion from contacts to the Hf oxide layers is a major problem, 2-) heavily arsenic doped junctions in source and drain regions where electrical deactivation occurs due to clustering of the dopant and 3-) Nb-based Nb2O5-PbO-GeO2 (NPG), glass photonic thin films where interesting optical characteristics such as observed high nonlinear third order optical susceptibility due to subtle structural variations in Nb local environment. Quantitative x-ray absorption spectroscopy analyses in these structures based on the data acquired at the National Synchrotron Light Source (NSLS) of Brookhaven National Laboratory will presented and the future of the synchrotron based spectroscopy and imaging in materials research with the recent opening of world's most advanced synchrotron source, NSLS-II will be discussed.

IS03

Metal Oxide Thin Film Characterization for New Generation Chemical Mechanical Planarization Process Development

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[keywords] Chemical Mechanical Planarization (CMP), Metal oxide nano-films, semiconductor interfaces.

This study targeted to create a basis for the new generation semiconductor industry that deals with atomic scale devices and also expected to be utilized in many other fields such as advanced coatings, interfacial adhesion, biological systems i.e. corrosion prevention and enhanced biocompatibility of bio-implants and nano/bio interfaces. We focused on the accomplishments on the microelectronics applications of the CMP process as it is used for the current and future semiconductor applications, such as metal CMP applications of the tungsten T-gate transistors, high speed shallow trench isolation transistors with germanium and furthermore isolating thin films for advanced microelectronics applications.

The preliminary model was developed on the very well established tungsten, which is being utilized as a gate dielectric for the novel T-gate transistors currently. Thin film analyses were conducted through advanced characterization techniques and also compared to the theoretical calculations for the modeling simulations. Atomic Force Microscope (AFM) was used to measure the surface roughness of the samples conditioned in the oxidizer environment before and after the CMP was conducted. The affect of surface roughness on wettability of the surfaces studied through contact angle measurements on the treated tungsten films. Attenuated Total Reflectance FTIR/ATR technique in combination with the X-Ray Reflectivity (XRR) was utilized to determine the thicknesses of the oxidized nano films on the tungsten wafers. The results were evaluated through the comparison of the Pilling-Bedworth ratios of the oxidized nano films to determine the ability of the created oxide films as a self-protective oxide [1]. The basic knowledge defined on the chemically modified thin films were also expanded to the germanium CMP applications. Particularly, formation and selective removal of chemically modified germanium/silica thin films in the presence of cationic and anionic surfactants were evaluated through AFM wear tests as well as CMP and surface wettability responses [2].

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IS04

Development of tip Scanning High Speed AFM operating at 1,000 Lines/s & 15µm

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[keywords] atomic force microscopy

High speed atomic force microscope allows imaging dynamic processes on the surfaces. We have developed a very high speed tip scanning atomic force microscope (HS-AFM). We designed the tip scanning system to overcome the sample size limits, with a beam tracking capability to follow the cantilever motion. A high resonance frequency flexure scanner developed which has 15µm scan range in XY and 3µm in Z axis. A novel FPGA based high speed scanning and data acquisition system was developed. The scanner is driven by sine wave in X-axis to avoid resonances and data were captured at equal sample intervals. 1 KHz line scan rate is achieved at 15µm scan range with the HS-AFM.

IS05

Nonlinear conversion of continuous wave light by all-plasmonic and molecular-plasmonic hybrid nanostructures

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Finding a possibility to control the activation of a single molecule is interesting since it paves the way to realize logic devices as small as molecules. This can be achieved by carefully designed devices which can interface a single molecule and interact with it at the same size scale. Such devices can be of electrical, magnetic or optical origin [1] and may induce changes in the properties of a single or few molecules which can act as switching registers for data processing or data storage at the nanometer scale. Optical devices that can interface a single molecule among an ensemble of many molecules are yet lacking. The main difficulty lies in the diffraction limit of practically ~150-180 nm focal size for a wavelength of 600 nm light. Compared to a few nm sizes of individual molecules, unambiguous activation of single molecules by means of absorption of light can only be possible for a device prepared from a sparse ensemble of molecules. Thanks to advancement in near-field optical instrumentation technology this main difficulty can be circumvented as the near-field light intensities typically have a very strong nonlinear dependence on distance. Strongly confined, highly intense fields of light called “hot spots,” can be achieved by engineering the nanoscale environment of a single molecule. By utilizing plasmonic resonances of nanoscale metal structures, such spots can be arranged to occupy from a few down to a single molecule. Nevertheless in these schemes, a broad far-field background component of the activation wavelength is inevitably superposed on to the near-field of the nanoparticles. In this study we propose a method which is feasible for deterministic activation of few molecules. We demonstrate effective background-free continuous wave nonlinear optical excitation of enhanced yellow fluorescent protein molecules that are sandwiched between asymmetrically constructed plasmonic gold nanoparticle clusters [2]. We observe that infrared photons are converted to visible photons through efficient plasmonic second harmonic generation. Our theoretical model and simulations demonstrate that nonlinear conversion of continuous wave light becomes possible by Fano resonance in the nonlinear response. We show that nonlinearity enhancement of plasmonic nanostructures via coupled quantum oscillators such as molecules can be several orders larger as compared to their classical counterparts [3-4]. It is shown that second harmonic generation enhancement in hybrid structures can be obtained even in the absence of coupled quantum emitters [5]. This is an important simplification for facilitating the use of purely metal nanoparticles with functionality.

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IS06

Magnetron Sputter Grown of W-Doped VO2 Layers on Glass Substrate for Thermochromic Applications

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Passive solar control glazings have an extensive use with their functionality of controlling the solar heat gain in order to decrease air-conditioning costs by reflecting or absorbing a very important part of the solar energy. However having the disadvantage of being unresponsive to different climate conditions by means of altering the heat and optical properties. Smart systems like electrochromic (EC) or thermochromic (TC) windows seem to be the best solution to overcome these disadvantages. Electrochromic systems are multilayered systems and their colour or transmittance values can be optimized by applying an external voltage. Thermochromic systems can automatically arrange their transmittance according to changes in temperature. In this study, TC systems and results will be presented. The target was to achieve VO2 phase which shows metal – insulator (M-I) transition at 68 oC. Afterwords, it was aimed to decrease the transition temperature to room temperature by W doping. In the literature, in general V-metal target is used to achieve VO2 phase. In this way very sensitive and controlled O2 flow is required [1]. Another approach is using V2O5 target and H2 gas as reactive gas to reduce O2 content by forming O-H radicals during coating [2-3]. In our study, V2O5 target is used without any additional reactive gas. Only Ar was used as process gas. In order to achieve VO2 phase the layers were grown at 550 oC and annealed at 600 oC.

From un-doped samples thermochromic transition temperature is found to be 67 oC with transmission difference of 46% in the infrared region. By W-doing the thermochromic transition temperature is decreased to 46 oC.

In order to achieve M-I transition at 46 oC the layer is transferred on to the 6 mm green glass by using simulation programs. Two simulation programs Windows 5.2 and OPTICS were used. As a result of the simulation it is observed that the system temperature can increase to 46 oC due to higher absorption properties of green glass. Since the termochromic transition temperature is found as 46 oC as experimentally it is clear that if the layer is grown on 6 mm green glass the thermochromic transition will occur without any additional heating of the system.

IS07

Correlated Electron States in Layered $CuxTiSe_2$

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CuxTiSe2 is a dichalcogenide that has a similar phase diagram as high-Tc cuprates and pnictides, with charge and superconducting order coexisting in parts of the phase diagram. The charge density wave mechanism is unique in that it is driven by a combination of excitonic and Jahn-Teller mechanisms. Intercalation of TiSe2 with copper atoms adds electrons to the conduction band near the Fermi surface, producing a metallic phase at room temperature and a superconducting phase at low temperatures with highest critical temperature of 4.15K. Both the charge density wave and superconducting phases rely on specific and, perhaps, competing carrier interactions at the Fermi surface. We used transient optical pump-probe spectroscopy to examine lattice dynamics and electronic order of bulk CuxTiSe2 single crystals.

In this work we examine the superconducting and CDW properties of CuxTiSe2 using spatial and time-resolved probes. We investigate bulk properties and atomic scale scanning tunneling microscopy and spectroscopy in CuxTiSe2. STM measurements reveal coexistence of chiral charge density wave and superconductivity. We also focus on transient response of electronic states as a function of temperature and copper doping from x=0 (semiconducting and CDW state) to x=0.08 (CDW and superconducting state). The fast optical response at low temperatures shows instability to excitations that are localized to the CDW part of the electronic band structure. This is accompanied by a weakening of excitonic contribution to the e-h recombination rates at x=0.04, signifying a possible transition from an Excitonic Insulator CDW to a Jahn-Teller dominated CDW.

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IS08

Tunneling Study on Multilayered Cuprates with two kinds of Crystallographically Inequivalent CuO_2 Planes

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[keywords] tunneling conductance, multilayered cuprates, superconducting gap

Our tunneling results on multilayered cuprates (MLC) with three or more CuO_2 planes per unit cell will be presented. It is well known that the superconducting transition temperature T_c increases with increasing n until n=3 then it saturates or decreases, where n is the number of CuO_2 planes in a unit cell, but the mechanism underlying high-T_c superconductivity is still under debate. Detailed spectroscopic studies on high-T_c cuprates have been extensively done on mono- or bi-layered cuprates, however those on MLCs have not been sufficient. The MLCs have two kinds of crystallographically inequivalent CuO_2 planes, where one is an inner square plane (IP) with four-fold oxygen coordination and another is an outer pyramidal one (OP) with five-fold coordination. Therefore it would be important to investigate the quasiparticle density of states for each of the CuO_2 planes. Up to now in MLCs, it becomes clear the local carrier concentration at IP is different from that at OP from NMR studies [1], and the different electronic states at the IP and OP produces two kinds of superconducting gap [2]. The superconducting gap at IP □(IP) is always larger than □(OP), and the difference □(IP)-□(OP) is getting larger with overdoping, this behavior suggests that the gain in carrier concentration at the OP with doping is larger than that at the IP. This is one of peculiar features of MLCs. On the other hand, the overall shape of the tunneling conductance for both the IP and OP on MLCs is similar to those observed for mono- and bi-layered cuprates, such as $Tl_2Ba_2CuO_{6+\square}$ [3] and $Bi_2Sr_2CaCu_2O_{8+\square}$ (Bi2212) in which an unusual dip structure behind □ together with *d*-wave like superconducting gap has been observed. The origin of tunneling dip structures has been discussed on bi-layered Bi2212 [4] and tri-layered $TlBa_2Ca_2Cu_3O_{8.5+\square}$ [5]. In this conference, we will show some new results on $Bi_2Sr_2Ca_2Cu_3O_{10+\square}$ (Bi2223) and discuss how to control the bulk-T_c of Bi2223 in which the T_c vs p behavior is unusual in the overdoped region.

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IS09

Ultra-thin glass & roll-to-roll processing: A brief summary of the status

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Glass can be categorized by many different parameters, with respect to its thickness, it is divided into three categories; flat glass (>1mm), curved glass (1-0.2mm), flexible glass (<0.2mm). Flexible glass with thicknesses of less than 200 µm is classified as "ultra-thin glass". Glass properties such as excellent optical quality, dimensional and thermal stability, chemical stability, oxygen and moisture barrier (the high permeation barrier), low surface roughness together with low weight make "ultra-thin glass" an attractive candidate among other flexible substrate materials. In the near future it would have an important share as substrate or encapsulation material in flexible substrate market. Thus there are numerous research and technical development activities at global scale to improve and optimize the properties of ultra-thin glass for large-scale roll-to-roll (R2R) processes for the manufacturing of "printed electronics".

The work is a brief summary of the status of opportunities and challenges in the R2R processing of flexible glass in different thin film deposition processes for applications such as flexible electronics, architecture, and energy conversion devices.

IS10

Elemental analysis of DLC thin films by LIBS

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Single-shot LIBS has been used for the analysis of DLC thin films on the silicon substrate produced by HIPIMSA Nd:YAG laser [EKSPLA, NL 301 HT, 1064 nm, multimode] with 4.4 ns pulse width (FWHM) was used in LIBS system (see figure). Depth profile information was obtained from the spectra of consecutive laser pulses. There were no spectral interfaces at the position of lines. The emission lines having similar upper level and ionization energy were selected for reproducibility analysis to reduce the effect of varied plasma condition due to the changes in experimental parameters. Low Z carbon element in thin film can be detected by LIBS technique under normal atmosphere and vacuum conditions. In DLC thin films Cr spectra become dominant after 1-2 shots it affects the determination of low concentrated elements. Spectral emissions of elements in DLC thin film were simulated using PrismSpect collisional radiative sofware and compared with experimental spectra.

IS11

Terahertz Response Properties of Microwave Kinetic Inductance Detectors (MKIDs) made of Ultrathin Superconducting Films

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[keywords] kinetic inductance, terahertz waves, detector

Terahertz spectrum between microwaves and infrared, is to be expected not only for wireless broadband communication but also for various kinds of imaging and analytical applications in security, medicine, and agriculture as well as material sciences. However, there is no imaging device satisfying both of the speed-speed and high-sensitive performances for terahertz waves. Microwave kinetic inductance detectors (MKIDs) originally developed for ultra-sensitive microwave detectors for radio astronomy purpose is a possible candidate of terahertz sensitive detector arrays with the easy multiplexing capability and simple device structure consisting of a superconducting monolayer. We propose NbN superconductor-based MKIDs as a sensitive terahertz imaging array. Although MKIDs were originally developed for ultra-sensitive microwave detectors for radio astronomy purpose, we invented a revolutionary MKIDs with a characteristic structure consisting of a superconducting rewind spiral indicating dual functional roles of microwave resonator as well as wide range terahertz antenna named “Spiral-MKIDs”. It is expected that the Spiral-MKIDs fabricated of few ten nanometers thick NbN film reveals NEP in the order of 10^{-14} W/√Hz above ~1THz corresponding to the energy gap frequency of NbN. The NbN-based Spiral-MKIDs can be operated using a commercially available liquid He free refrigerator. We present terahertz response properties of Spiral MKIDs made of ultrathin NbN films. Thickness of terahertz sensitivity of the NbN-Spiral MKIDs will be discussed.

IS12

Electrochemical Synthesis of Iron Chalcogenide Superconductors and Enhancement of Superconducting Property

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[keywords] Iron based superconductors, iron chalcogenide superconductors, 11-system, layered compound, electrochemical synthesis, excess iron, de-intercalation.

Superconductivity is a phenomenon of exactly zero electrical resistance occurring in certain materials when cooled below a critical temperature (T_c). The research aims to fabricate the superconducting wire for power cable and magnet is promoted by discovery of iron based superconductors due to their high T_c and small magnetic field dependence of critical current density. Iron chalcogenide superconductor, so called 11-systems, has the simplest crystal structure among iron based superconductors. Furthermore, drastic increase of T_c from 8 K to around 40 K in FeSe is achieved by stress, which is introduced under high pressure or from substrates to thin film. In addition, 11-systems have high upper critical field and low anisotropy, which place them significant candidate for a wire application under high magnetic fields.

As a new route to fabricate iron chalcogenide superconducting wire, we focused on an electrochemical reaction. Generally, electrochemical reaction can deposit a uniformly thin film on the various conducting substrates and is also effective way to remove or insert ions. To date, we have succeeded in synthesis of FeSe superconductor electrochemically [1-3]. Furthermore, we have reported that electrochemical reaction is also effective way to remove excess Fe, which suppresses superconductivity of 11-systems, and to enhance superconducting property [4, 5]. Therefore, the combination of these two electrochemical processes is a promising method to fabricate the superconducting wire by continuous process. Synthesis of iron chalcogenide superconductors and improvement of superconducting property by electrochemical reaction will be discussed.

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IS13

Photoelectrochemical and optical properties of films deposited from nanosheets of layered materials

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Two-dimensional nanosize sheets as macromolecules have received a great attraction in the last decades. Studies on nanosize sheets, especially those of transition metal layered oxides and graphene, have revealed the potential of nanosize sheets in the photoelectrochemical, electrochemical and photocatalytic applications. Layered materials as photocatalysis are attractive and promising future technology for renewable and sustainable energy challenge which includes clean energy production (H_2 production from water splitting), decrease in the CO_2 emission levels (by CO_2 reduction) and elimination of hazardous organic pollutants under solar light or other illuminating light source. Films deposited from nanosheets of perovskite type layered materials can be utilized for photoelectrochemical applications. Another unique property of perovskite type layered materials is their luminescent behavior as a result of self-emission, or host-guest interaction.

Graphite is also a very important and attractive material due to its excellent thermal and electrical conductivity, high mechanical strength, and extremely high surface area. Graphene obtained by exfoliating graphite shows these excellent properties in nano-dimensions. This wonder material has already expanded its applications by blending with noble metals, metal hydroxides and oxides.

Herein, I will demonstrate the results of our recent studies on these layered materials. I will represent emission and upconversion properties of films deposited from nanosheets of perovskite type layered oxides. In addition, photoelectrochemical behaviour of these type of materials will also be revealed. Furthermore, I will demonstrate utilization of graphene-metal composites as electrode materials for electrochemical capacitors and catalysts for ammonia decomposition reaction.

IS14

Atomic Layer Deposition of III-Nitride Thin Film Semiconductors and Their Electronic and Photonic Device Applications

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[keywords] Atomic layer deposition, GaN, Thin Film Transistor, Photodetector

For many electronic and optical applications, III-nitride materials are much sought after due to their direct and high optical band-gap, high electron saturation velocity and band-gap tunability. These important features enable many possible device applications, which are generally used in high power and high frequency applications. However, these films are generally grown using high temperature and high vacuum processes namely, MOCVD, MBE which limit substrate selection along with CMOS compatibility. In our work, we offer an alternative way of growth to fabricate thin film transistors (TFTs) and UV metal-semiconductor-metal (MSM) photodetectors. Hollow cathode plasma assisted Atomic Layer Deposition (HC-PA-ALD) technique make low temperature device applications possible. We have grown GaN and InGaN films and analyzed TFT and photodetector properties in detail. Electrical and optical characteristics of such devices are investigated. The results can pave the way for ALD to be used for III-Nitride based electronic and optical devices. Thin film transistor exhibit 2x103 ON/OFF ratio with threshold voltage of 11.8 V. MSM photodetectors, on the other hand, showed 20 pA under -20 V voltage bias with a UV responsivity of 680 μA/W under 290 nm incident light with only a 20 nm thick film. The talk will also present next generation memory device applications of ALD based thin films

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IS15

Manipulating Room Temperature Magnetic Skyrmions

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Magnetic skyrmions are a perfect example for the ensuing complexity of mesoscale magnetism stemming from competitions between interactions crossing many lengthscales [1]. The interplay between applied magnetic fields, magnetic anisotropies, as well as symmetric and antisymmetric exchange interactions, can stabilize topologically distinct spin textures known as magnetic skyrmions. Due to their topology magnetic skyrmions can be stable with quasi-partcile like behavior, where they can be manipulated with very low electric currents. This makes them interesting for extreme low-power information technologies [2], where data is envisioned to be encoded in topological charges, instead of electronic charges as in conventional semiconducting devices. Towards the realization of this goal we demonstrated at room temperature stable magnetic skyrmions in magnetic heterostructures, which can be manipulated using spin Hall effects [3]. Furthermore, using inhomogeneous electric charge currents even allows the generation of skyrmions in a process that is remarkably similar to the droplet formation in surface-tension driven fluid flows [4]. Lastly, we demonstrated that the topological charge gives rise to a transverse motion on the skyrmions, i.e., the skyrmion Hall effect [5], which is in analogy to the ordinary Hall effect, which is due to the motion of electrically charged particles in the presence of a magnetic field.

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IS16

An investigation on structural and magnetic properties of crack healing $(Cr_{1-x}Mn_x)_2AlC$ coatings

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[keywords] Magnetic MAX Phase, Self-healing, Oxidation.

Cr_2AlC is categorized among a family of materials which have the $M_{n+1}AX_n$ structure (MAX phases) and are intrinsically formed as nanolaminates [1]. It has been recently shown that incorporation of Mn into this material system can trigger magnetism in addition to its well-known unique combination of metallic and ceramic properties [2, 3]. Previously, $(Cr_{1-x}Mn_x)_2AlC$ thin films have been synthesized using magnetron sputtering with different elemental targets [4]. It has been predicted [2] and experimentally revealed [4] that Mn is replaced by Cr in the *M*-sublattice resulting in magnetic ordering in the Mn-rich regions [5].

Here, $(Cr_{1-x}Mn_x)_2AlC$ films with a thickness range of 12-20 µm were deposited by dc magnetron sputtering in an industrial deposition chamber on polycrystalline Al_2O_3, MgO(100), and MgO(111) substrates. A combinatorial approach is utilized using a split compound target facilitating the formation of a Mn concentration gradient. Energy dispersive X-ray spectroscopy measurements show that up to 5 at.% of Mn were incorporated into the coatings. Structural analysis was conducted by X-ray micro diffraction and magnetic measurements were performed with a vibrating sample magnetometer in a temperature range of 5-600 K. The films are to be oxidized step-wise in air for the temperature range of 900-1300 K for the time sequences of 15 and 30 min in order to achieve different oxide thicknesses. Changes in structure, and the magnetic response of the as grown and the oxidized coatings were correlated with the Mn content.

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IS17

Nanocomposite optical coatings for solar energy conversion

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[keywords] nanocomposites, photovoltaics, solar absorbers, thermochromics, electrochromics

Due to their fascinating optical and electronical properties, nanocomposite coatings play an important role in solar energy conversion [1]. Physical effects of the nanometric scale can result in interesting new material properties which might be exploited in solar energy conversion.

This overview tries to illustrate the large variety of existing and envisaged solar energy applications of nanocomposite optical coatings.

Nanocomposite dielectric films are used in novel multilayered coatings on glazing of photovoltaic modules and thermal collectors [2]. Such coatings combine a colored reflection with a high solar transmittance and open new possibilities for the architectural integration of solar panels in building facades.

Embedded nanometer-sized metal clusters play an important role for selective solar absorber coatings. Nanocomposite Cu-Co-Mn-Si oxides can be deposited by a low-cost sol-gel process, are extremely stable at elevated temperatures, and might be useful as receiver coatings for thermoelectric power and industrial process heat generation [3].

Thermochromic films based on vanadium dioxide might be used for overheating protection for solar thermal systems. The material undergoes a reversible phase transition from the semiconducting monoclinic to the metallic tetragonal phase, inducing a strong change in the thermal emissivity. The temperature-dependent complex dielectric function has been determined by multiangle FTIR NIR-MIR ellipsometry [4], and can be used for the design of novel multilayered smart solar absorber coatings.

Innovative nanocomposite thin film materials might improve the properties of electrochromic smart windows. Next generation switchable glazing shall exhibit faster optical switching, stronger contrast between clear and colored state, improved homogeneity and energy efficiency of switching, as well as superior durability.

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IS18

Development of device processing strategies towards achieving highly efficient organic solar cells

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Organic solar cells (OSCs) based on bulk heterojunctions (BHJ) of conjugated polymers such as poly (3-hexylthiophene) (P3HT) and fullerenes such as (6,6)-phenyl-C61 butyric acid methyl ester (PCBM) have received significant attention over the last few decades due to their low cost processing, compatibility with flexible substrates, high throughput and thus reduced capital investment. Power conversion efficiencies (PCE) in the region of 7% have been achieved [1] and PCE of 10% or larger [2] is projected for the foreseeable future, which makes OSCs a viable replacement of the well- established silicon solar cells. Performance of such devices however is limited by a number of factors, mostly related to device processing, which includes choice of the most appropriate fullerene, type processing solvent for best nanostructured BHJ network, optimization of active layer thickness and post deposition treatment of these layers. Furthermore, the choice and the treatment of the electron and hole transport layers at the collecting electrodes have been invariably shown to play a paramount role in improving device performance. In this presentation an overview of intensive ongoing research carried out in order to develop strategies with the aim of optimizing OSCs performance as well as their long-term stability by looking into effects of all above mentioned parameters using UV-visible absorption spectroscopy, XRD, AFM, SEM, electrical conductivity as well as current density-voltage (J-V) measurements, both, in dark and under illumination. Electrical conductivity as well as dark J-V characteristics were analysed using Richardson-Schottky model as well as space charge limited conduction theory to evaluate the diode properties of the produced solar cells. Improvement in the physical properties of the PEDOT:PSS as the hole transport layer proved to be a key factor towards enhancing the P3HT:PCBM bulk heterojunction (BHJ) solar cells, with power conversion effeciency reaching values as high as 6.82% associated with high fill factor (61%) and larger short circuit current density. The development of new active layers comprising P3HT:PCBM-based hybrids with single-walled carbon nanotubes or graphene will also be discussed in the this presentation.

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IS19

Intrinsic Josephson properties and superconducting fluctuation in $PbSr_2Y_{1-x}Ca_xCu2O_{7+\delta}$ epitaxial films

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In high-temperature superconductors, two-dimensional layered structure is considered as an essential nature for their superconductivity. The superconducting order parameter is localized at superconducting layers and blocking layers between the superconducting layers work as charge reservoirs. It has been known that the thickness of the blocking layer determines the superconducting anisotropy; however, the anisotropy of YBCO with Cu in the blocking layer is particularly low. This can be explained by introducing a specific role of Cu atoms in the blocking layers. $PbSr_2Y_{1-x}Ca_xCu_2O_{7+\delta}$ (Pb1212), which contains not only Pb but also Cu in the blocking layers, is expected to provide a large variation of anisotropy parameter. We have been successful to grow Pb1212 epitaxial films with T_c up to 90 K[1]. In this talk, we first suggest a generic explanation of superconducting anisotropy after presentation of systematic change in the c-axis transport properties. Second, we argue the presence of superconducting fluctuation above the onset of resistive superconducting transition Tc_{on} through terahertz time-domain spectroscopies (THz-TDS) of Pb1212 epitaxial films. We measured current-voltage (I-V) characteristics along the c-axis of Pb1212 epitaxial films with various Cu concentrations. With increasing Cu in the blocking layer, maximum Josephson current increases and the hysteresis of I-V curve is less pronounced. This suggests that Cu atoms in the blocking layers dramatically decrease anisotropy. The comparison with other cuprates has revealed the relevance between the components of blocking layers and the c-axis conductivity. It is found that macroscopic energy gap values of metal oxides in blocking layers have close relation with the microscopic nature of the c-axis conductivity in Pb1212 and other cuprates [2]. The complex conductivity at the frequencies from 0.2 to 1.0 THz in the under-doped and optimally-doped Pb1212 epitaxial film was investigated by THz-TDS. By analyzing temperature and frequency dependence of the complex conductivity, we found that the superconducting fluctuation persists up to 12 K above Tc_{on} for the underdoped film. Compared with previous reports, the superconducting fluctuation in Pb1212 is observed shorter temperature range than $Bi_2Sr_2Ca_1Cu_2O_{8+\delta}$ and $La_{2-x}Sr_xCuO_4$. This is ascribed to the lower anisotropy of Pb1212[3].

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IS20

Modelling of Cascade Defocussing in Irradiated Nanoporous Materials

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[Keywords] Nanoporous Materials, nanovoids, primary knock-on atom

Nanoporous materials have emerged very recently as a class of candidate structural materials for advanced nuclear reactors. It has been found that they are potentially more resistant to radiation damage than more normal bulk structures materials. Computer modelling has been used to explore and explain the response of nanoporous materials to irradiation. The modelling has provided fundamental understanding of the atomistic processes responsible for the experimental observations. Were it has been noted that the internal structures are more robust against the displacement damage created by the passage of an energetic primary knock-on atom (PKA) created by neutron irradiation. However, a detailed investigation of the behaviour the cascade initiated by such a PKA reveals some interesting features. The presence of voids in the nanomaterials causes the cascade to spread-out around the void walls essentially defocussing the cascade and lowering the resulting displacement damage with the ultimate effect of changing the complexity, and hence stability, of remaining defects after the cascade has completed. Depending upon the size of the voids the cascades are more or less defocussed spatially. It is also noticed that the cascade is also defocussed in time as the lower velocity parts of the cascade spread across the void more slowly than the more energetic recoils. This affect further defocusses the cascade.

In the work presented here we use LAMMPS to simulate a PKA initiated cascade in both a crystalline Fe target containing a set of nanovoids of the order of 20nm in size and a set of Fe spherical crystalline nanoparticles of 20nm diameter which have random orientation with respect to each other. A 10keV PKA is then initiated from various positions and the ensuing cascade is followed and the distribution and density of defect production is observed as a function of time.

IS21

Metasurface Filters for Terahertz Applications: Design, Fabrication and Characterization

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Technologies based on terahertz waves (300 GHz – 10 THz) are developing rapidly. Some of the most promising developments in recent years has been in the area of imaging and communications. Realizing that almost all non-resonant dielectric media are transparent and almost all conducting media are not transparent in this frequency range, materials which exhibit both characteristics can be extremely useful and need to be explored fully to exploit various terahertz photonics applications. THz frequency range metasurface structures are typically composed of a dielectric substrate and patterned metals such as gold, silver and copper. The high conductivity of the metal is important to enhance the transmission of the THz radiation through the structure. For this reason, in recent years superconductor based metamaterials have been developed to achieve modulation and tunability by controlling temperature and the applied magnetic field [1] [2]. Although metal based metamaterials have many advantages such as ease of production, patterning and high conductivity, they are not transparent in the visible region. Two examples of such materials which our group has been working on recently are superconductors such as YBCO which show conductive behavior at low temperatures and ITO which shows conductive behavior at room temperature. Patterning of these materials into meta-surfaces on suitable substrates can allow for frequency selectivity which is a requirement for many of the aforementioned fields [3]. These works are discussed in the context of current mm wave/THz stand-off imaging and communications investigations taking place in our laboratories.

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IS22

Development of microwave kinetic inductance detectors for ground-based CMB polarization experiment "GroundBIRD"

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Cosmic microwave background radiation (CMB) is the oldest electromagnetic radiation we can observe in the universe. The observations of its 2.7 K blackbody spectrum and its anisotropy strongly support the Big Bang cosmology, and also strongly imply the "inflation" before the bang. In order to prove its presence, the best way is to find the sign of the primordial gravitational waves. The waves are expected to imprint the rotational polarization patterns named "B-mode" on the CMB. The precise measurement of the spatial spectrum of the polarization distribution is strongly required. For this purpose, we are developing the ground-based experiment, GroundBIRD. The telescope is planned to be situated in Canary Islands and its operation will start in 2017. In this presentation, we will show the current status of the development.

GroundBIRD introduces several key technologies to realize the low detection limit for the CMB polarization observations such as a high-speed rotating telescope, cooled optics, and microwave kinetic inductance detectors (MKIDs). The high-speed rotating telescope is realized by a mechanical cryostat on a rotating table. We have newly developed a rotary joint to pass through the high-pressure helium gas as well as the electrical lines. The joint enables us to connect the head of the cryostat to the compressor placed on the ground. By combining the mechanical cooler with a 3He depressurized stage (He-10), we have achieved the holding time of more than 24 hrs with the continuous rotation at 20 rpm. The rotation enables us to scan a wide range of sky continuously and repeatedly. The expected 'multipole' coverage is $6 < l < 300$. The rotation is also advantageous to reduce the 1/f noise of the atmospheric perturbation.

We have adopted a cold optics below 4K to suppress the radiation noise. The size of the aperture window is 30 cm in diameter. To minimize the incident thermal radiation, the metal-meshed filters and the radio-transform multi-layer insulations (RT-MLI) are utilized. The latter consists of a set of stacked formed-polystyrene layers. Each layer is transparent to radio waves and opaque to infrared radiation. Because the RT-MLI is cooled down by itself by radiating heat, no thermal link is required. Its performance does not change even if the aperture size changes.

As the focal plane detector, we have adopted MKIDs because of its fast response time (~50-100 μs), a large number of pixels, and high sensitivity. The fast time response is crucial for the high-speed scanning observations. The readout of MKIDs is based on the frequency domain multiplexing, and it enable us to realize a large-format detector array. The number of pixels is 109 and 330 pixels at 220 and 145 GHz, respectively.

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SPECIAL SESSION

SS01

Development of a High Selective Insulating Glass Unit

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High-T Low-E, sputter coating

Functional solar selective optical coatings on glass have been developed to control the heating or cooling loads for buildings and automobiles. This type of coatings include Ag layer/s sandwiched in a magnetron sputter vapor deposited (MSVD) multilayer stack. Practical usage of this kinds of coated glass is either being a component in an insulating glass unit (IGU) or in a laminated windshield. The ratio of transmittance of infrared to visible wavelengths determines the selectivity of the product. In this study; an insulating glass unit with a high selectivity of Tvis min / g max: 75 / 35 is aimed. Selectivity increase is focused on improving the properties of Ag layers and base layers' for Ag. Deposition parameters of Ag and base layers' were changed by conducting an inline MSVD system located at Sisecam Science and Technology Center. Selection of less absorbing glass substrate and/ or antireflective coating on other glass surface, which will face the inner space of IGU, are second order improvement actions.

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SS02

Effects of Heat Treatment on Iron-oxide Coated Glass

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Spray pyrolysis, Soda lime silica glass, Fe2O3 coating, Tempering, Morphology

Colored glasses are widely used in architectural applications. One of the possible techniques to produce colored glass is coating glasses with optical thin films. Iron-oxide coatings are attractive candidate for coloring of glass due to their unique color.

The aim of this study is to investigate the effects of heat treatment on Iron-oxide coatings on glass. In this study soda lime glass was coated with Fe2O3 by utilizing spray pyrolysis technique. In the first step, Fe containing organometallic precursor was dissolved in various solvents followed by spraying onto different hot glass substrates for different periods of time. Subsequently, coated glass was tempered or exposed to heat which caused a change in structure. Morphology, structure and optical properties of the coated glass were investigated by surface sensitive characterization techniques such as X-Ray Photoelectron Spectroscopy, X-Ray Diffraction, Atomic Force Microscopy, UV-Visible Spectroscopy, Fourier Transform Infrared Spectroscopy and Ellipsometry. Results of the experiments showed that duration of the heat treatment changes the morphology, structure and color of the coating. Also, changing the solvent of the precursor or substrate directly affected the color of coating.

SS03

Defect Analysis of Multilayer Thin Films on Glass

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[keywords] Solar control, low emissivity, multilayer, thin film, glass.

Increasing demand on the energy efficient buildings, increases the use of solar control and low emissivity thin films on architectural glasses. These multilayer thin films consist of metallic, oxide and oxynitride layers which were deposited by magnetron sputtering. Thickness of layers change from 1nm up to 40nm, depending on the optical design and required mechanical properties.

Production of glasses with solar control and low emissivity thin films, generally requires a secondary process such as thermal toughening. During thermal toughening glass temperature goes up to 700°C. At high temperatures, structural and chemical changes which have detrimental effect on the multilayer thin films may occur due to diffusion and oxidation phenomena.

In this presentation, structural, chemical, optical and mechanical characterization of layers and defects in the multilayer thin films before and after thermal toughening will be discussed.

SS04

Long Afterglow Duration Phosphorescent Paint System for Glass

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[Keywords] Aluminate-based phosphors, glass coating, bluish-green phosphorescence, phosphorescence paint, afterglow.

The pigments, inevitable components of the paint, have been known and used since the humans first started painting. Organic or inorganic, inert or active, the pigments are fine particle-sized substances that are incorporated in a binder for a variety of reasons. A simple way to classify pigments is to consider them as colorant, extender, anti-corrosive and effect pigments.

Phosphorescent pigments, after being excited by a light source, will continue to emit light after the excitation stops. Aluminate based crystals with phosphorescence ability show this capability due to the 5d-4f orbital transition of a suitable dopant. In this system, the energy levels of intermediate orbitals of the dopant determine the wavelength (i.e. color) of the emitted light.

Due to their excellent photo resistance and chemical stability, great brightness, long-lasting emission time, environmental safety as well as showing no emission radiation, aluminate based phosphorescent pigments are used in various applications such as luminous paint, ink, safety indicator, etc.

The objective of this study was to investigate the preparation and characteristics of afterglow paint system for glass decoration. By using two different aluminate based phosphorescent pigments in polymeric coating, it was found that these pigments emitted green and blue light with high intensity. The paint system developed in this study was optimized in order to obtain long afterglow duration.

Contributed Talks

CT01

Electrical Properties of Semiconductor Nanowires

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[keywords] conductance quantization, nanowires, semiconductors.

In the paper some properties, especially electrical conductance and thermal conductance, of semiconductor nanowires are discussed. We have analyzed and measured nanowires created of silicon and germanium because of using both Si and Ge for manufacturing of integrated electronic devices. Electrical conductance G_E and thermal conductance G_T of a nanostructure describe the effect of electron transport in nanowires. Electrical conductance quantization in nanowires has been observed in units of $G_0 = 2e^2/h = (12.9\ \mathrm{k}\square)^{-1}$ up to five quanta of conductance according to the theory proposed by Landauer. In the paper we present our measurements of electrical conductance quantization in Ge, Co (Fig. 1) and Au nanowires at room temperature. The thermal conductance quantization is considered in a similar way like the electrical conductance. In one-dimension systems are formed conductive channels. Each channel contributes to a total thermal conductance with the quantum of thermal conductance G_{T0}. Quantized thermal conductance and its quantum (unit) G_{T0} was confirmed by Schwab. The quantum of thermal conductance G_{T0} [W/K] = $(\pi^2 k_B^2/3h)T = 9.5\times10^{-13}T$ depends on the temperature. At T = 300 K value of $G_{T0} = 2.8\times10^{-10}$ [W/K]. This value is determined for an ideal ballistic transport in a nanowire, with the transmission coefficient t_{ij} = 100%. It means that in all practical cases (when t_{ij} < 100%) the thermal conductance is below the quantum limit.

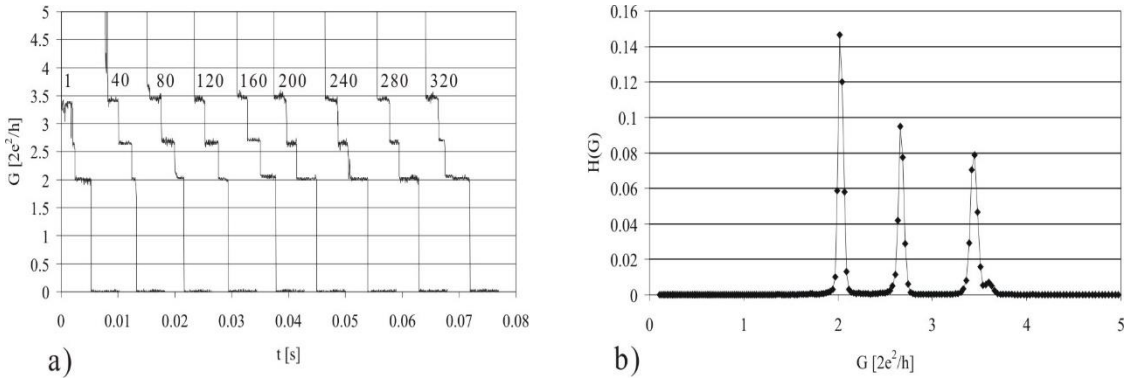

Fig. 1. Room-temperature conductance of nanowires formed between a Co tip and a Ge plate. (a) Electrical conductance curves of nanowires; (b) histogram exhibiting the statistical conductance for Co-Ge.

In small structures a dissipated energy is quite large. For the first step of conductance quantization, $G_E = G_{E0} = 7.75\times10^{-5}$ [A/V], and at the supply voltage V_{sup} = 1 V the current in the circuit I = 77 μA. The power dissipation in terminals of nanowires is $P = I^2/G_{E0}$ = 76 μW for the first step of conductance quantization. One can notice that the density of electric current in nanowires is extremely high. The diameter of the silicon nanowire on the first step of quantization can be estimated to D = 0.5 nm, so for I = 77 μA the current density $J \approx 4\times10^{10}$ [A/cm^2].

CT02

In vivo assessment of TiNi coated with oxide and polymer films

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Keywords: *in vivo*, coating, TiNi, TiO_2, SiO_2, ZrO_2, DL-PLG, DL-PLA, PMMA.

After more than 60 years since the discovery of the shape memory effect in equiatomic TiNi [1], the alloy is still intensively studied. TiNi shows one of the highest shape-recovery-rate among materials exhibiting the shape memory effect. It has also excellent mechanical and corrosion resistance properties [2]. Due to presented properties TiNi is very appealing for the medical field, where numerous applications were already implemented [3]. However, the large amount of Ni content induced a reticence in using the TiNi implants without taking supplementary precautions for avoiding side effects generated by ion release (Ni proved to be an allergen, toxic and carcinogen element).

To obtain a "zero" side effect of TiNi implants, current efforts are dedicated to block the Ni/Ti ion release by creating a barrier between the implant and the tissue [4]. Moreover, Liu *et al.* showed that TiNi alloy coated with TiO_2 film had improved blood compatibility [4]. Another approach is to deposit functional films, such as drug release films [5, 6]. Films that include drugs should be biodegradable, in order to allow the medicine to be released in the human body, and fulfil its purpose. Xi *et al.* [7] investigated the degradation behavior of a polymeric coating on cobalt-chromium stent platform. On the other hand, Xu *et al.* studied the biodegradation behaviors of PLGA stents both *in vitro* and *in vivo* to explore the usefulness of biodegradable polymeric stents in human common bile duct (CBD) repair and reconstruction [8].

Our work proposes a comparative analysis of deposited inorganic/organic sandwich-like layers on TiNi substrate. Coatings consisted of an oxide XO_2 (X=Si, Zr, Ti), or of the oxide covered atop by a polymeric layer, e.g., poly (lactide-co-glycolide), (DL (PLG) - $[C_3H_4O_2]_x[C_2H_2O_2]_y$). The main role of XO_2 coatings was to block the Ni/Ti ion diffusion into tissue and of the polymeric layer to carry and deliver the appropriate drugs. As-prepared samples were implanted in rabbits. At the end of short-term (10 days) and long-term (60 days) experiments, samples were extracted and the nearby tissue was investigated. Temperature of rabbits during experiments was monitored. Coatings features vs. their implantation effects are presented and discussed. Positive results were encountered for various combinations of layers.

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CT03

Conformal Coverage of Trenches and 3D Structures in a Reactive Process using Remote Plasma Sputtering

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[keywords] Remote plasma sputtering, conformal coverage, substrate bias

With the progression towards higher aspect ratios and finer topographical dimensions in many micro- and nano-systems, it is of increasing importance to be able to conformally deposit thin films onto such structures. Sputtering techniques have been developed to provide such conformal coverage through a combination of coating re-sputtering and ionised physical vapour deposition (IPVD), the latter by use of a secondary plasma source or a pulsed high target power (HiPIMS).

This paper reports on the use of an alternate remote plasma sputtering technique in which a high density ($>10^{13}$ cm^{-3}) magnetised plasma is used for sputter deposition. The remote plasma sputtering is an inherently continuous IPVD process (not needing a secondary discharge) and through the use of substrate bias the arrival characteristics of sputter flux ions and plasma ions can be controlled [1].

For both a metallic and reactive process it has been shown that a low substrate bias attracts a higher sputter flux to the substrate (up to 80 % for Al_2O_3) and with high enough substrate bias re-sputtering of the deposited material occurs.

Through the reactive deposition of Al_2O_3 onto complex structures, scanning electron microscopy (SEM) and energy dispersive X-ray spectroscopy (EDX) results demonstrate that applying a negative substrate bias during film growth can result in re-sputtering of deposited material and Al_2O_3 film growth on surfaces obscured from the initial sputter flux.

Deposition of Al_2O_3 onto 5:1 aspect ratio structures has shown that through control of the substrate bias the coating thickness on the vertical and horizontal planes can be varied. For low or zero substrate bias the majority of the coating will deposit on the horizontal planes. Employing a substrate bias > -267 V results in the majority of the coating being deposited on the side walls. This occurs through the attraction of ionised sputter flux and re-sputtering of the thin film on the horizontal surfaces due to ion bombardment. It has been shown that by alternating the substrate bias between -222 and -267 V, with a 50 % time at each voltage, conformal coverage of 5:1 aspect ratio structures can be achieved. It is expected that further optimisation of the process parameters will lead to a uniform film thickness on all surfaces of high aspect ratio structures.

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CT04

Growth of WN_xO_y thin films and modifications by ion impact

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Key words; WN_xO_y thin film, Electronic- and atomic-structure modifications by ions

We have grown WN_xO_y films on C-plane-cut-sapphire (C-Al_2O_3) substrate using reactive-RF-sputter method with W target and N_2 gas. According to X-ray diffraction (XRD), a strong peak appears at the diffraction angle (2θ) ≈37 º and a weak peak at ≈78 º. These peaks are assigned as WN, referring to JCPDS card data. No peaks were observed other than WN and C-Al_2O_3 (2θ=41.7 º). The substrate temperature was optimized to be 425 ºC so that the XRD intensity takes its maximum. Rutherford backscattering spectroscopy (RBS) of 1.8 MeV He^+ ions leads to the composition, x=1.1 and y=0.4 within RBS accuracy of 20 %. We have also investigated modifications of the films by ion impact and it is found that the electrical resistivity of unirradiated film (0.03 Ωcm) is reduced to $4x10^{-4}$ Ωcm by 100 MeV Xe ion at $4x10^{14}$ cm^{-2} and the XRD intensity decreases to ~1/200 at 10^{13} cm^{-2}. It also appears that the resistivity of unirradiated film increases with decreasing temperature from RT to 30 K like semiconductor and irradiated film shows very weak temperature dependence.

CT05

Catalytical Micromotors

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[keywords] micromotor,catalytical,miRNA.

Iron oxide particles MRI), drug delivery and nano/micro motors [1]. In this study, It was used Fe_3O_4 and plasma-OH modified Fe_3O_4 nanoparticles for application of micro motors. Fe_3O_4 and Fe_3O_4- OH nanoparticles were firstly dispersed in pure water helping with ultrasonic bath then drip to well clean glass and dried in atmospheric air conditions. Using Rf magnetron sputtering technique, they were coated with Platinum (Pt) as catalyst with fuel of Hydrogen peroxide (H_2O_2). The speed of micro motors was measured by using Nikon Eclipse Fluorescence Microscopy with changing H_2O_2 and surfactant (Triton X-100) concentration. SEM-mapping was used for chemical characterization of micromotor surface. In optimized conditions (% 10 wt. H_2O_2 and %5 Triton X-100) miRNA sensing of Fe_3O_4 and Fe_3O_4-OH micro motors are studied depending on target concentration and hybridization time parameters.

Acknowledgements
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CT06

Growth and characterization of thin films for various purposes

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[keywords] Thin oxide films, hafnium oxide, vanadium oxide, VO_2, In_2O_3:SnO_2, ITO, Cu_2ZnSnS_4, CZTS, solar cells.

We have grown hafnium dioxide (HfO_2), vanadium-oxide (VO_2), In_2O_3:SnO_2 (ITO) and Cu_2ZnSnS_4 (CZTS) by magnetron sputtering technique. HfO_2 is a good candidate for applications in next generation metal-oxide-semiconductor (MOS) technology due to its high dielectric constant (κ=25) [1], reasonable energy bandgap (E_g >5 eV) [2] and thermodynamic stability on Si substrate. Vanadium dioxide (VO_2) which is a transition metal compound demonstrates metal insulator transition (MIT) property. The transition carries out at nearly 68 °C [3]. VO_2 exhibits insulator phase with monoclinic crystal structure at low temperatures below the transition, while metallic phase with tetragonal crystal structure at high temperatures above the transition. Since the electrical resistivity of VO_2 at MIT changes by a factor of 10^4, it has high potential for the applications in microelectronic devices. It is used not only for FET applications, but also for other devices including nonvolatile resistive memories, optical sensors and thermochromics smart windows. Among the transparent conducting oxides (TCOs), indium tin oxide (ITO) is a material with low resistivity (~10^{-4} ohm.cm) and high transparency (~90%) [4]. As a result of these properties, ITO is transparent in the visible and reflective in the infrared spectral regions. It is used as electrode in LCD displays, photovoltaic cells, antireflection coating, heat reflective mirrors, transparent electromagnetic shielding, optical sensor and opto-electronic device. Cu_2ZnSnS_4 (CZTS) as an absorber layer for thin film solar cells is a promising candidate due to not only its low cost but also nontoxic properties contrary to CdTe and Cu(In,Ge)Se_2 (CIGS). CZTS has a direct bandgap of 1.4-1.6 eV and a large optical absorption coefficient of about 10^4 cm^{-1}. Therefore, CZTS is an ideal absorber layer for photovoltaic devices [5]. Beside these good advantages, the components of CZTS are also earth abundant and less toxic when compared to those of CIGS.

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CT07

Influence of ZnO Buffer Layer Deposition Temperature on the Microstructure and Properties of CdTe Based Solar Cells

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[keywords] CdTe, ZnO, buffer layer, characterisation, analysis

CdTe based photovoltaic devices are being developed for space and terrestrial applications. The thin film solar cells have been deposited directly onto flexible and UV radiation resistant cerium-doped microsheet glass (CMG) by metal organic chemical vapor deposition (MOCVD). For space applications, the use of CdTe solar cells deposited onto CMG offers a reduction in weight and an increase of specific power compared to current solar cells. The devices are deposited in a superstrate configuration with the following multilayer structure: CdTe/CdZnS/CdS/ZnO/AZO/CMG. Incorporation of a ZnO buffer layer has improved the cell performance and currently, the highest efficiency obtained for these solar cells is 15.3%. The thin film solar cells have been characterized by means of x-ray photoelectron spectroscopy (XPS), scanning electron microscopy (SEM), x-ray diffraction (XRD), atomic force microscopy (AFM) and scanning transmission electron microscopy (STEM). The 700 nm AZO layer exhibits a compact columnar structure with dome shaped surface features varying in diameter between 20 and 200 nm. Deposition of the ZnO layer on the AZO at 340 °C gives rise to a layer which does not exhibit a columnar structure, but is comprised of small spherical grains of 30-50 nm in diameter, indicative of a high nucleation rate. This layer shows a semi-porous structure within the solar cell. Increasing the ZnO depostion temperature to 400 °C leads to the nanocrystallites exhibiting a more faceted morphology and increased grain size, due to a lower nucleation rate. The porosity of this layer is much reduced. The effect of the different ZnO layer morphologies on solar cell performance, particularly V_{OC}, is characterised and discussed.

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CT08

Improving Ionic Conductivity of $Li_{0.5}La_{0.5}Ti_{1-x}Al_xO_3$ Solid Electrolyte by Al-substitution

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[Keywords] Ionic conductivity, $Li_{0.5}La_{0.5}Ti_{1-x}Al_xO_3$, Thin-film electrolyte, Magnetron Sputtering

Rechargeable Li-ion cells are key components of the electronic devices required by today's information-rich, mobile society [1]. So, as it is clear that power requirements become more demanding, batteries are also expected to provide higher energy densities. Lithium-based batteries have begun to fill this need due to the higher energy densities that enables us to store at a minimized volume when produced as thin film. Further, lithium is very lightweight and has a high electrochemical equivalency and these properties make lithium an attractive battery [2]. All solid state batteries utilize solid state electrolytes to overcome the safety issues of liquid electrolytes. Drawbacks for all-solid state lithium-ion batteries include high resistance at ambient temperatures [3]. To get rid of this problem, in particular, some studies reported that Al for Ti substitution increases the ionic conductivity of LLTO [4]. Therefore, in this study, experimental studies were accomplished in two stage: target preparation and thin film growth. LLTO target was prepared by mixing the powders (La_2O_3, Li_2CO_3, TiO_2) in appropriate stoichiometric rate. The mixed powder was put in a crucible, calcined at 1200 oC for 6 hours in air, repeating two times. Then, the powder is pounded again, put in a circular Cu base plate and pressed with a cylindrical button. As a result, 2 inch circular disc-shaped target is formed. In order to fabricate solid state electrolytes with high ionic conductivity, thin- film electrolytes of $Li_{0.5}La_{0.5}Ti_{1-x}Al_xO_3$ were grown by RF magnetron sputtering in Ar atmosphere. In order to investigate effect of Al_2O_3 on ionic conductivity, additional amounts of Al_2O_3 in compositions were prepared by conventional solid state reactions as target for the thin film deposition process. It is observed that at a certain amount it has beneficial effect on ionic conductivity. Also for the grain growth, anneal treatment is conducted. Furthermore, structural, compositional properties were characterized by SEM, XRD, Raman spectroscopy and XPS. In addition, ionic conductivities of the thin films and pellets, produced from different Al_2O_3 compositions, were determined from impedance spectroscopy results. Results show that enhanced ionic conductivity obtained with Al doping.

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CT09

Development of Novel Ultrasonic Viscosity Measurement Technique via E/M Impedance Modelling of SH-PWAS Embedded into Liquid Media

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[keywords] shear horizontal, standing ultrasonic waves, piezoelectric active sensor, electromechanical impedance, viscosity

In this paper, an electromechanical in-situ ultrasonic measurement method is to be developed for determination of viscosity change of industrial oils at room temperature and atmosperic pressure. Electromechanical impedance spectroscopy (EMIS) method is to be utilized in the measurement technique which will be developed. This method uses piezoelectric sensors that work in electromechanical principles as resonator and dynamically determines the characteristics of a medium that the resonator interacts. One of the extensively employed sensor technologies has been permanently installed piezoelectric wafer active sensor (PWAS) for in-situ continuous structural health monitoring (SHM). Using the transduction of ultrasonic elastic waves into voltage and vice versa, PWAS has been emerged as one of the major SHM sensing technologies. EMIS of PWAS-liquid medium couple is a high frequency local modal sensing technique by applying standing waves to indicate the response of the PWAS resonator by determining the resonance and anti-resonance frequencies. This method utilizes the shear horizontal piezoelectric wafer active sensor (SHPWAS) to generate shear horizontal mode standing waves. Piezoelectric wafer active sensors are polarized and excited by electric field such that it can vibrate in shear horizontal mode. To simulate the actual EMIS measurements in the present work, three-dimensional coupled field finite element analysis (CF-FEA) models of SHPWAS submerged in liquid media are created in a commercial multi-physics FEA software, ANSYS®. The electrical impedance of an element depends on the physical properties of the element itself as well as on the acoustic properties of the surrounding medium. The acoustic parameters, namely the velocity and the attenuation, are directly linked to the elastic properties and microstructure of the embedding liquid medium. Then for evaluation purposes, the resolution of the so called inverse problem makes it possible to recover the ultrasonic properties of the surrounding medium from the measurement of the electric impedance of the piezoelectric sensor. The EMIS values of the specimens in in different viscosities are going to be simulated in broad-band of frequency spectra using CF-FEA models. An statistical correlation between the EMIS values and the viscosity values are established via the root mean square deviation (RMSD) method resulting in an index of property change. The paper ends with summary, conclusions, and suggestions for possible future applications

CT10

Optimized preparation of ZnO:B hazed contact layers for a-Si:H/μc-Si:H thin film solar cells with light trapping effect

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[keywords] transparent conductive oxide (TCO), thin film solar cells, optical haze, light trapping.

The broad use of ZnO:B transparent conductive oxide (TCO) layers as a front contact material for amorphous (a-Si:H) and tandem (a-Si:H/μc-Si:H) silicon thin film solar cells is caused by an excellent combination of good optical transparency, high electrical conductivity and rough surface structure, which provides light trapping effect typically characterized by the optical haze value [1]. The synthesis of such a kind of surfaces requires the optimization of deposition process regimes and it may also significantly affect the further formation of silicon microcrystalline layers influencing the solar cells performance [2].

The ZnO:B layers were deposited by chemical vapour deposition (CVD) at 170-215 ºC temperature and 0.5-1.5 mbar pressure with different DEZ/water gas precursors flows, where diborane gas (B_2H_6) was used for boron doping. The ZnO:B films optical haze was varied between 2 and 50 % (at 600 nm wavelength) combining the thickness variation (from 700 to 2700 nm) and other deposition parameters. The a-Si:H and μc-Si:H layers (as in the case of tandem solar cells configuration) were deposited by plasma enhanced chemical vapour deposition (PECVD) at 40 MHz plasma excitation mode, where previously obtained ZnO:B hazed structures were used as substrates. Optical and electrical properties of ZnO:B layers were studied by integrating sphere spectrometer and Hall measurements respectively, while the upper deposited a-Si:H/μc-Si:H films were investigated by Raman spectroscopy (514 nm excitation) under the subsequent calculation of their crystallinity factors [2]. The surface roughness was estimated by AFM measurements.

It was found that the crystallinity of deposited a-Si:H/μc-Si:H structures correlates with the optical haze and surface roughness of ZnO:B substrate layers, on which they were deposited (e.g. the Raman crystallinity factor is ~5 % decreased for the optical haze increase to 50 %). The light trapping properties of TCO layers are reaching the optimum when their optical haze is >20% (which gives ~65 % light absorption within 400-1100 nm wavelength range for corresponding glass/ZnO:B/a-Si/μc-Si structures). This is also accompanied with a significant decrease of a-Si:H/μc-Si:H band-gap value.

The paper will present the discussion on the preparation of ZnO:B films with different optical haze values and their effect over the crystallinity of further formed a-Si:H/μc-Si:H layers considering structural properties, light trapping effects and the solar cells performance.

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CT12

Surface Modification and Temperature Dependence of Free Carrier Life Time of Silicon Solar Cells

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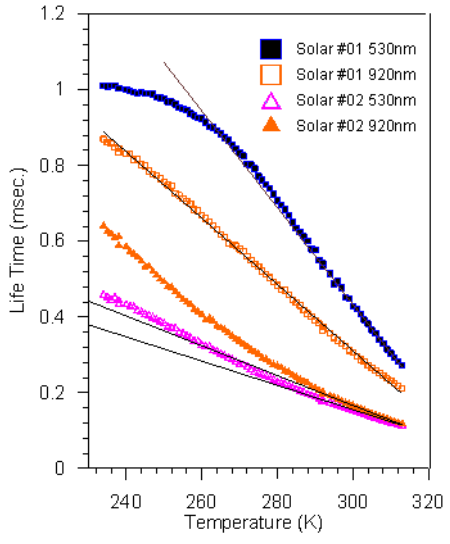
[keywords] Solar cell, efficiency, life time, open voltage decay

Solar cells are used for harvesting solar energy directly. Usability of this technology is under the press of cost per watt energy generated by final solar cell. One of the main factor is the energy conversancy efficiency and the efficiency is defined by the selected material and affected by the architecture of structure. On the other hand, starting material and final device quality is one of the main concern. The most important parameter for any solar cell is the life time of photo generated free carriers. Direct life time measurement on a solar cell is possible under the low light intensity excitation and to be calculated from digitized open voltage decay. In this study we have investigated crystalline and amorphous silicon solar cells. Life time of crystalline n^{++}Si/p-Si/p^{++}Si/Al structure with and without texturized front surfaces are measured at 77-340K range using 532 nm 920nm pulsed laser excitation. Surface roughness of structured and unstructured solar cells were 1.18µm and 0.0057µm, respectively. Life time measurements between 77-340K indicate that structured solar cell life time at 300K is 400µsec and reaches to 1msec level below 250K. But life time of unstructured solar cells found to be 200µsec at 300 K and reaching to 0.85msec below 150K. As shown in table, temperature coefficient at ±40ºC range indicating modification of surface for efficiency have negative effect on temperature coefficient of life time but even at +40ºC life time of structured surface is better than reference solar cell. Further the effect of surface passivation to be discussed in detail.

	Solar #01 **Unstructured**	Solar #02 **Structured**
Excitation	Life Time Temp. Coefficient µsec/K (-40 - +40 ºC)	
530 nm	-12,8	-3.2
920 nm	-8,7	-3.9



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CT13

Enhancement of Electrical Conductivity of Plasma Polymerized Fluorene-type Thin Film under Dopants: Iodine and Chlorine

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[keywords] Fluorene-type thin film, plasma, conductivity, iodine, chlorine, biphenyl.

Electrical conductivity of plasma polymerized fluorene-type ($C_{13}H_{10}$) thin films are investigated in situ utilizing two separate dopant materials: iodine and chlorine. These materials play an important role on the transport of electric charges in polymer films [1, 2]. The hole density of film increases as result of the presence of the electro-negative atoms and their attraction with pair of electrons. Doping process results in an additional level in band structure. Fluorene-type thin films are produced by using a mixture of biphenyl ($C_{12}H_{10}$) and methane (CH_4) plasma. The dopants are exposed to the plasma directly as vapor during the deposition. Plasma reactor is a single capacitively coupled glow plasma system consisting of two parallel plate electrodes. The films are deposited on the glass and silicon substrates. In previous studies, the fluorene-type thin films surfaces are proven to be suitable for photovoltaic applications [3]. The purpose of this work is to enhance the conductivity of material so that it will be compatible for photovoltaic devices such as organic solar cells and organic light emitting diodes (OLEDs). In this study, the plasma depositions are generated for a range of plasma parameters, CH_4 flow rate, and deposition time at constant pressure of 200 mTorr. The breakage of the ring structures and formation of new group compounds with the iodine and chlorine are chemically evaluated by Fourier Transform Infrared (FTIR) spectroscopy. The optical properties of the deposited films are observed using a UV-visible spectroscopy. The current – voltage characteristics are measured via a two-point probe technique and the conductivities are analyzed for two types of polymer films generated with the iodine and the chlorine dopants.

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CT15

Effect of Hydrogen on the Performance of amorphous Indium gallium Zinc Oxide (a-IGZO) Thin Film Transistors

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[keywords] a-IGZO, TFT, Hydrogen.

Amorphous In-Ga-Zn-O (a-IGZO) are promising for developing thin films transistors (TFTs) because of their large electron mobilities, small subthreshold voltage swing, and low temperature fabrication process. a-IGZO TFTs are largely used in high-resolution active-matrix organic light-emitting diode displays (AMOLEDs) and liquid crystal displays (AMLCD) [1,2]. The impurity hydrogen in gallium-indium-zinc oxide a-IGZO create deep defect near valance band minimum (VBM) which may cause instability. In this study we have investigated the effect of hydrogen on output parameter a-IGZO TFTs by two-dimensional numerical simulation (Silvaco). Our results indicates that the standard model does not reproduce measurements [3]. We therefore adopted the well known defect pool model for amorphous silicon to a-IGZO which gave much better results. The threshold Voltage (Vth) increase with increasing of Hydrogen and states near VBM concentration.

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CT16

Real Microstructure and Electrical Properties of Palladium Oxide Thin Films for Oxidizing Gases Detecting

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[keywords] microstructure, gas detectors, palladium, palladium oxide

Because of health problems and noxious effects on vegetation caused by atmospheric pollution in industrialized countries, air quality control is becoming of great interest [1]. Monitoring of ozone and nitrogen dioxide concentration in the atmosphere is a critical task for human health protection. Various types of binary and ternary metal-oxide semiconductors recently have been widely used for oxidizing gases detection [2, 3].

The main purpose of this work is to study the real microstructure and electrical properties of palladium oxide thin films for detecting gases with oxidizing properties.

Palladium oxide thin films (thickness was about 20 – 40 nm) were prepared by thermal oxidation of previously formed by thermal sublimation in vacuum Pd layers on amorphous C/KCl (100), optical quartz, and polished poly-Al_2O_3 substrates. Thickness of initial Pd layers was controlled by duration of metal vapour condensation at average speed of this process ~ 0.016 nm per second. Oxidizing of Pd films was performed by an annealing in dry oxygen atmosphere at temperature T = 520, 570, 670, 820, 920, and 1070 K within one hour. By HREED method it has been established that irrespective of the substrate nature the initial Pd layers were highly dispersive polycrystalline with random orientation of grains. The grain size varied within the limits from 0.5 up to 6 nm. The lattice parameter of Pd fcc crystal lattice is a = 0.3912 ± 0.0002 nm and is in excess of etalon value on 0.6 % . By RHEED investigations it has been found that Pd layers annealing at temperature T < 570 K did not result in change of their phase structure. The annealing at 570 K < T < 820 K resulted in formation of two phase films. HREED patterns have shown the presence of PdO with Pd simultaneously. The rise of the annealing temperature up to T = 920 K and T = 1070 K led to formation of homogenous polycrystalline PdO films. It has been determined that PdO films are characterized with tetragonal crystal lattice with parameters a = 0.3043 ± 0.0002 nm and c = 0.5337 ± 0.0002 nm. Measurements of electrical properties confirmed p-type of conductivity of PdO films with energy band gap ~ ΔE_g = 2.15 - 2.3 eV. Sensor properties of PdO thin films were testified by detecting of oxidizing gases presence in air. Particularly, at process of ozone quantitative detecting in air within concentration interval 0.005 – 0.5 mg/m^3 PdO films have shown high values of sensor response ($S \approx 100$), signal stability, and reproducibility of sensor response, which were proved by results of multiple recycles of measurements with the same ozone concentrations.

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CT17

Optical Chracterization of the Layered Zinc Oxide Thin Films by Using Genetic Algorithm

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[keywords] Layered ZnO thin films, Sol-gel, Genetic Algorithm, Optical constants.

In this work, two groups of ZnO thin films were deposited by using Dip Coating (DC) and Ultrasonic Spray Pyrolysis (USP) techniques. The first group of thin films deposited using DC technique in the form of FilmA/substrate and FilmA/substrate/FilmA. Second group of ZnO thin films deposited on the dip coated sample (FilmA) by using USP technique (FilmB) in the form of FilmB/FilmA/Substrate. Genetic algorithm (GA) method is used in the different ways for several studies to determination of optical constants of thin films [1-4]. The optical constants of all films were determined with GA method considering with the model based analysis procedure. The functional form of $n(\lambda)$ and $\alpha(\lambda)$ was used to extract optical parameters such as film thickness, refractive index (n) and absorption coefficient (α) from the experimentally measured optical transmittance. The GA method which was successfull in retrieving model based calculated transmittance is agree with experimentally measured optical transmittance for computer made and real films. One of the advantages for this method is considerably quicker and no need for successive parabolic interpolation and extra calculation. In addition, the quantity of the interference fringes is not as critical to the ability to perform the GA in comparison with the classical methods such as envelope method.

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CT18

Multilayer Nanoparticle Deposition of Indigo Dyed Warp Yarns for Functional Properties

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[keywords] Layer-by-Layer, indigo dyed warp yarn, functional properties, nanoparticles.

The Layer-by-Layer (LbL) deposition process is based on the sequential adsorption of oppositely charged colloids such as charged molecules, nanoparticles, dyes, proteins and other supramolecular species [1,2]. The LbL process has initiated the easy preparation of nano-composite textile fibers to be used in the manufacture of functional textiles [3]. Indigo dyed warp yarns were purchased from GAP Textile and used for obtaining denim fabrics which will gained self-cleaning and tensile strength properties. The cationic indigo dyed warp yarn was prepared by using two different commercial cationic dye fixing agent. Anatase titanium oxide nanoparticles (particle size <25 nm, specific surface area 200-220 m^2/g) and Aluminum oxide nanoparticles (particle size < 50 nm, specific surface area 40 m^2/g) were purchased from Aldrich and used for multilayer film composition. The isoelectric point of anatase TiO_2 and Al_2O_3 nanoparticles are at pH 4.7-6.2 and 9.2, respectively. The pH of nanoparticle suspensions was adjusted for anionic and cationic groups according to isoelectric points of nanoparticles to different pH values by using NaOH and HCl. 1, 3 and 5 g/l nanoparticle suspensions were prepared at 40 W for 1 h by Sonics Vibra-Cell Ultrasonic Homogenizer. In the deposition process, the cationized and untreated warp yarns were deposited with 10 multilayer nanoparticle films. Multilayer film coated warp yarns were dried at 60 °C and cured at 130 °C for 3 min. Attenuated Total Reflectance Fourier Transform Infrared Spectroscopy (FTIR-ATR) and Scanning electron microscopy (SEM-EDX) were used to verify the presence of deposit nanolayers. Photocatalytic activities of the nanocomposite films were evaluated through the degradation of red wine pollutant. Tensile strength tests of the warp yarns were achieved to evaluate the effect of solution pH values changes during the alternate dipping procedures and the deposited nanoparticles.

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CT19

The Manipulation of Oxygen and Chlorobenzene Molecules on the Si(111)-7x7 Surface with Scanning Tunneling Microscopy

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[keywords] Oxidation, semiconducting surfaces, chlorobenzene, electronic excitation, scanning tunneling microscopy.

Functionalized atomically thin 2-D semiconductor surfaces with individual atoms or organic molecules provide unique properties for microelectronic and photonic device technologies. The scanning tunneling microscope is a great tool to determine not only the structure of atomically thin layer but also manipulate the individual atoms and molecules [1].The main purpose of this work is to understand the initial adsorption states and study *local* and *non-local* manipulation of oxygen and chlorobenzene molecules on the Si(111)-7x7 surface at RT. The molecules are manipulated far from the tip by electronic excitation of the bond between adsorbate and surface atoms. First, a bright and dark site of oxygen configurations are observed on the Si(111)-7x7 surface [2]. The bright site decreases with increasing oxygen dosage from 0.3 L to 0.4 L. The local manipulation of the bright and dark sites of oxygen molecules is performed a wide range of bias voltage (+3.7 to +10.0 V) for an electron injection of 50 ms. A displacement, transformation and desorption of oxygen molecules are observed due to electron injection on the sites. Moreover, only the manipulation of the dark sites are possible the range of 2-5 nm via non-local electron injection in a corner hole. The desorption of chemisorbed chlorobenzene molecules induced by local charge injection on the molecule. Increasing the amount of charge decreases the excitation time of the molecule from the surface. Moreover, a regime of 40 Å diameter, which is suppressed by the STM tip, was observed for the first time and omitted by Sloan *et al*. [3] by the non-local desorption of chlorobenzene molecules via electron injection on a corner hole. We studied the effect of increasing tunneling current from 0.2 nA to 8 nA (thus decreasing tip-sample separation) on the suppression regime. It is found that the region is independent from the tip-sample separation.

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CT20

Detailed optical and electrical examination of obtained by using various thin film deposition techniques Fe_2O_3/ZnO structure

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[keywords] Fe_2O_3, ZnO, Spray Pyrolysis, Sputtering, Resistance. Magnetic materials

Multifunctional Fe_2O_3/ZnO structure has recently become the subject of intensive research due to their interesting physical properties and potential applications. Among all magnetic materials have attracted special attention of the scientific community due to their numerous vital applications e.g. in nanomedicine [1]. Wang et al. reported the synthesis of CdS/Fe_3O_4 and CdS/a-Fe_2O_3 hetero structures having magnetic, optical and photo-catalytic properties [2]. Hong et al. showed higher photo-catalytic activiy of Fe_3O_4/ZnO composite than that of ZnO [3]. In this study we firstly obtained ZnO thin films on glass at 450 ^oC substrate temperature by using Chemical Spray Pyrolysis (CSP) technique. ZnO is a wide band gap semiconductor (Eg.~3.37 eV) and the high efficiency of luminescence in the UV to visible regions of the spectrum makes ZnO an attractive material for optoelectronic applications [4]. ZnO thin film optical properties have been investigated by using UV-Vis. duple-beam spectrometer and Photo-Luminescence (PL) measurements. We obtained that band gab of ZnO thin film has been calculated as 3.15 eV. Also structural analysis of ZnO thin film has been examined by using SEM, EDX, XRD techniques and electrical properties of the film investigated by four probe point technique. Then, we deposited Fe_2O_3 thin film on ZnO thin film by using radio-frequency (Rf) magnetron sputtering of a Fe target at 100 W/cm^2. The preparation of iron oxide thin films can lead to devices with attractive optical, magnetic, and semi-conducting properties, which can be tailored by altering the preparation parameters and among all the vacuum processes used for producing films, the sputtering process is one of the most popular [5]. Thus we obtained Fe_2O_3/ZnO structure on glass.

We finally detailed optical and structural characterization of deposited Fe_2O_3 thin film on ZnO thin film substrate by Rf magnetron sputtering was investigated UV-Vis. duple-beam spectrometer, PL and SEM, EDX, XRD techniques, respectively. Likewise electrical properties of Fe_2O_3 thin film investigated by four probe point technique. Furthermore, it is observed that resistivity of the Fe_2O_3/ZnO structure has been measured as 23 kΩ.

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CT21

Study of Parameters for A Highly Reflective Thin Film

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[keywords] Thin films, Silver coatings, Electroless deposition, Reflective surfaces.

Reflective thin films have a variety of application areas such as solar collector systems for thermal and photovoltaic applications, optical mirrors, illumination armatures, laser applications, etc. Silver and aluminum coatings are commonly used reflective materials used in concentrating solar power systems [1] although silver is the most reflective material in the visible region [2]. Silver films can be deposited on substrate surfaces by various methods such as electron beam lithography, plasma-assisted deposition, magnetron sputtering, and chemical vapor deposition [3]. However, they must be carried out under high vacuum environment and also can not be used in large-scale coatings. Electroless plating method is a promising option for silver deposition on arbitrary substrates at low cost, under low temperature and with easy controlled process parameters.

This work focuses on development of highly reflective surfaces produced by silver coating for use in solar collector systems. Silver coatings were deposited in aqueous medium using silver mirror reaction. The method is based on adsorption of $[Ag(NH_3)_2]^+$ complex ions onto the substrate surface and then the reduction to elemental silver Ag^0 with the addition of an aldehyde as reductant. Parameters such as concentration of $[Ag^+]$, reduction time, effect of additives (such as alcohols, capping agent, etc.) were investigated within this study. Surface morphology of the silver film coatings were characterized by scanning electron microscopy, and their crystal structure by X-ray diffraction method. Surface reflectance was measured by UV-Vis spectroscopy. XRD results proved the growth of silver film on the substrates and also showed that no impurities were present in the film. SEM images were used to confirm the measured reflectance values. More evenly distributed and smaller-sized spherulite-shaped crystals were observed for surfaces with high reflectance. Reflectance value of 96% was achieved by optimization of the process parameters.

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CT22

Development of Protective Nano-Coatings for Electro-Optical Systems

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[keywords] thin film, chemical vapor deposition (CVD), optical coating.

After the invention of lasers, field of the electro-optics has continued to develop rapidly. In recent years, especially electro-optical (EO) imaging systems usage have been improved quietly in military and civil aviation in order to find a source, detect small objects, provide night vision etc. [1, 2] In these applications, EO systems are exposed to quite harsh and unstable operating conditions like sudden changes in temperature, humidity, dust, fog, physical shock, vibration and radiation. If their optical surfaces such as prisms, lenses and mirrors are damaged because of these conditions, their repair usually is not possible. To mitigate these problems, it is necessary to develop special protective coatings for optical surfaces. The main goal of this study is to produce self-cleaning and super-hydrophobic polymeric or hybrid thin films for protection of optical surfaces of the EO systems without any measurable loss in optical performance. Chemical vapor deposition (CVD) of polymers is a suitable method for the fabrication of thin film coatings and it has many advantages such as low production cost, low temperature, 3D geometry coating performance and high deposition rate.

In this study, we present modeling and fabrication of single and multilayer, polymeric/hybrid protective nano-coatings based on super hydrophobic materials (refractive index of 1.3 to 1.7) with 10 to 500 nanometer thicknesses fabricated by CVD. The thickness uniformity, surface roughness, chemical, mechanical and optical properties were thoroughly characterized by a variety of analytical techniques including Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM) and Fourier Transform Infrared Spectroscopy (FTIR) and reflectometry. In addition, coating performance tests such as adhesion, temperature durability, moisture, salt resistance, detection of scratches and holes etc. were performed following Military Standards (MIL-STD).

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CT23

Effect of Aromatic SAMs Molecules on Graphene/Silicon Schottky Junction

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[keywords] Schottky diode, graphene, self-assembeled monolayers.

Graphene is a one-atom thick sheet of sp^2 bonded carbon atoms that are arranged in a honeycomb crystal lattice with exceptional properties. When transferred on to semiconductors such as GaAs, GaN, SiC and Si; it forms Schottky junctions [1]. More efficient and stable solar cells and Schottky barrier devices will be achieved by the development of surface improvement, doping and functionalization [2]. The electrical transport performance of the fabricated Schottky diode is directly based on interface properties between substrate and graphene layer.

Self-assembled monolayers (SAMs) are well-oriented molecular structures that are formed by the adsorption of an active surfactant on a substrate surface. Aromatic SAMs were used before to modify anode/hole transport layer interface in order to achieve preferable barrier alignment and charge carrier injection [1,2]. In this study, n-type silicon substrates were modified by novel MePIFA and DPIFA SAM molecules to improve grafene/Si interface properties and increase charge carrier injection. Schottky diodes were fabricated by CVD grown graphene layers that were transferred onto bare and SAMs modified n-type silicon substrates. Electronic characteristics of the diodes were investigated by forward bias current-voltage measurements at room temperature. Atomic Force Microscopy (AFM) and Kelvin Probe Force Microscopy (KPFM) techniques were used to obtain surface morphology and surface potential properties of the bare and SAM modified film surfaces.

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CT24

Comparison of Back contact - CZTS Interface Resistance for Various Sulfurization Processes

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[Keywords] Cu2ZnSnS4, thin film, solar cell, back contact resistance, efficiency.

New generation of inorganic solar cells are Cu_2ZnSnS_4 (CZTS) thin films, in which sulfur, zinc and tin are replaced with selenium, indium and gallium in previous generation, $CuInGaSe_2$ (CIGS), respectively [1]. The great interests and efforts were concentrated on the developments of CIGS solar cells which led to CZTS solar cells. The components of CZTS solar cells are earth abundant and non-toxic [2]. CZTS also has near ideal properties for solar photovoltaics, as it is a very strong absorber and has a band gap of around 1.5 eV [3]. In this study, CZTS absorber layers were fabricated by magnetron sputtering of Cu, Zn, Sn thin film layers on flexible titanium and molybdenum foil substrates which were annealed in an Ar + S_2(g) atmosphere. We aimed to investigate the role of flexible titanium and molybdenum foil substrates in the growth mechanism of CZTS thin films, so we needed to perform some analysis in order to confirm the suitability of CZTS thin films as the absorber layer in solar cell applications. One of these analysis is measurement of back contact interface resistance. This technique is an electric measurement and device performance testing for semiconductors. In this method, the measurement is done by measuring the current with respect to scanning an applied voltage across the solar cell and the current of intended area of solar cell is plotted against the applied voltage. This measurement at the first step of coating and before adding next layer helps us to remove the defects which prevent high efficiency because of direct connection between substrate and the first coated layer. In this study, the back contact resistance of deposited CZTS during rapid sulfurization and slow sulfurization processes were measured and the results were compared in order to understand the efficiency of each process after CZTS coating and before making device. The current –voltage (I-V) curve after silver (Ag) evaporation by using mask, was carried out between the bare area of flexible titanium foil as substrate and upper surface of CZTS deposited with Ag to characterize the performance of fabricated layer. The back contact resistance for each process was approximately the same and it showed low differences in rapid sulfurization process as well as short sulfurization process as calculated from the I–V curve.

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CT25

An Investigation on Tribological and Corrosion Behavior of Graphene/Nickel Multilayer Composite Coatings

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[keywords] Graphene/nickel composite coating, electroless nickel coating, graphene, electrophoretic coating, wear resistance, corrosion resistance.

In this study, wear and corrosion resistance of multilayer Graphene/Nickel coating was performed. The coating processes were carried out on steel substrates by mixture of electrophoretic and electroless coating methods. Firstly, reduced graphene oxide were deposited on the steel substrate via electrophoretic deposition. After electrophoretic graphene deposition, an additional layer of electroless nickel was deposited in order to improve the corrosion resistance and reduce cracks on the substrate. The microstructure, microhardness, tribological features of nanocomposite coatings were evaluated in detail. Microhardness of the composite coating was measured using a Vicker's microhardness indenter. Scanning electron microscopy (SEM) was performed to characterize the surface of the composite coating. Raman spectroscopy, EDS and XRD analysis were used to determine the chemical composition of composite coatings. Potentiodynamic polarization and electrochemical impedance spectroscopy (EIS) were used to study the corrosion behavior of the coatings. The tribological behaviors of the electrodeposited Graphene/nickel multilayer composite coatings sliding against an M50 steel ball was examined on a CSM Instrument. The tribological behavior of the resultant composite coating was tested by a reciprocating ball-on disk method at constant load for determination the wear loss and friction coefficient features against a counterface. All the friction and wear tests were performed without lubrication at room temperature and in the ambient air (with a relative humidity of 55–65 %).

CT26

Electrical properties of p-n diodes based on undoped and Iodine doped ZnO nanorods prepared by hydrothermal method

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[keywords] ZnO nanorods, hydrothermal method, Current–voltage characteristics, impedance spectroscopy.

Iodine-doped Zinc oxide nanorods (ZnO:I) at different percentage (5-20%) were deposited on p-Si and glass substrates using an a hydrothermal method. The effect of Iodine element content on the morphological, structural, optical and electrical properties of ZnO:I films was investigated by scanning electron microscopy, X-ray diffraction and UV-Visible spectroscopy. The doping with iodine resulted in a slight decrease in the optical band gap energy of the films. The junction properties of the diode were evaluated by measuring the current–voltage characteristics. The I-V characteristics showed rectification behavior with a rectification ratio dependent on the applied voltage and the Iodine doping rate. ZnO/p-Si heterojunction diodes exhibited non ideal behavior with an ideality factor higher than unity. The barrier height for undoped and Iodine-doped ZnO/p-Si diodes was in the range 0.64-0.76 eV. By means of the Impedance spectroscopy analysis, we investigated the frequency relaxation phenomenon and the equivalent circuit of such a structure. Finally, the effect of the iodine doping rate on the spectral response was studied.

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Optical Properties of Encapsulated Nano-Sized Si in SiO_2 Fabricated by Ion Implantation and Reactive PLD

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[keywords] Si nanocrystals, Photoluminescence, Ion implantation, Pulsed laser deposition.

After first reports on room temperature visible photoluminescence (PL) in the early 1990s [1,2], great interest in the optical properties of Si nanocrystals has grown over the last decade because of their potential applications toward Si-based integrated optoelectronic devices. Our group has focused on the formation of silicon nanocrystals, and developed the first examples of luminescent Si nanocrystals inside of SiO_2 using ion implantation. Nowadays, it is well known that Si ion implantation into SiO_2 and subsequent high temperature annealing (more than 1000 ^oC) induce the formation of luminescent Si nanocrystals. The PL peaking in the near infrared or visible spectrum (between 1.4 eV and 1.8 eV) is evidently related to implanted Si nanocrystals formed by decomposition of the SiO_x phase and aggregation with high temperature annealing. In this work, the potentialities of excimer UV-light (7.2 eV), e-beam irradiation and rapid thermal annealing (RTA) to enhance the PL and to achieve low temperature formation of Si nanocrystals have been investigated. Together with, we prepared specimens of Si nanocrystals embedded in a SiO_2 by reactive pulsed laser deposition (PLD) in an oxygen atmosphere. We will make clear the similarities and differences with the way of preparation. The samples used were prepared by implanting Si^+ ions into oxidized Si epitaxial layers grown on p^+-type Si wafers with oxide thickness of around 500 nm. The Si ions were introduced at acceleration energy of 180 keV with the fluence 7.5 x 10^{16} ions/cm^2. The implanted samples were subsequently annealed at 1050 ^oC or 900 ^oC in a flowing N_2 atmosphere for 4 hours using a conventional tube furnace. Some of the samples were UV-light (172 nm, 7.2 eV, Xe_2^*) irradiated for 2 hours with power density of 50 mW/cm^2 in vacuum, or rapidly thermal annealed at 1050 ^oC in N_2 atmosphere for 5 minutes with a rising rate of 50 ^oC/sec. We also prepared Si nanocrystals embedded in a SiO_2 by reactive PLD in an oxygen atmosphere. Si sub-oxide (SiO_x, $0<x<2$) films were firstly deposited on Si wafers, by using conventional PLD system with 2nd-harmonic YAG laser (532nm, 10Hz) under controlled low oxygen pressure (0.4Pa – 1.2Pa). After deposition in the oxygen ambient, the SiO_x films were annealed for 4 hours at 1050 ^oC in N_2 atmosphere to induce the formation of Si nanocrystals. We found that the luminescence intensity is strongly enhanced with excimer-UV lamp irradiation and RTA. Moreover, effective visible PL found to be observed even after FA at 900 ^oC. Based on our experimental results, we discuss the effects of excimer-UV lamp irradiation and RTA process on Si nanocrystals related PL. In case for PLD produced samples, PL intensity increases with increasing oxygen gas pressure, and then decrease. We found that the maximum intensity can be obtained with oxygen pressure of 0.6Pa. It is also noted that the peak energies of the PL are affected by ambient oxygen pressure. Based on our experimental results, we also discuss the effects of oxygen pressure during PLD on the PL intensity.

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CT28

Amyloid-Like Protein Membrane: A Natural Biosensing Platform

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In this study, we performed an enzyme immobilization platform by applying low pressure plasma (RF) to a natural amyloid-like protein membrane. For this purpose, a model protein, bovine serum albumin (BSA), was chosen mainly for enhanced supporting property. To procure electrospinnable solution of BSA, beta-mercaptoethanol (β-ME) was used to induce tertiary structure and low ratio (1.5:1.0 TFE:PBS (pH: 7.4)) of 2,2,2-triflouroethanol (TFE) was added as a stabilizing agent, respectively. The electrospun membranes were activated with RF plasma treatment by employing ethylenediamine (EDA) as a precursor to activate the membranes' surface by incorporating amino (-NH_2) groups. Those surfaces were then crosslinked with glutaraldehyde aqueous solutions at concentrations between 0.01- 5.00 % (w/v), which followed by the covalent attachment of glucose oxidase (GOD). The performance of enzyme immobilized membranes was tested by employing amperometric measurements against various glucose concentrations in terms of response time, enzymatic activity and linearity. The effects of plasma parameters and cross-linking conditions on the performance of enzyme electrode were also studied. The results indicate that, incorporating more amino groups on the surface of the membrane didn't affect the enzymatic activity and the performance of the electrode positively. It is just because of the stearic hindrance of the enzyme molecules that were bound to amino groups to create an active single layer. To demonstrate this, Fourier Transform Infrared Spectrometry (FTIR-ATR) measurements were carried for each membrane to investigate amino groups related immobilization ratios correlation with overall activity of the membrane.

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The Frequency Dependent Capacitance Characterization of Co:ZnO/Si Heterojunction

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[keywords] Co:ZnO, Ultrasonic Spray Pyrolysis, Capacitance-frequency characterization.

In this study, it was aimed to search the capacitance-voltage characteristics of the Co:ZnO/*p*-Si heterojunction structure as a function of the temperature. For the ZnO-based heterojunction sample, *n*-ZnO film was deposited on the low resistivity (0.1-10 Ωcm) *p*-type Si (100) substrate by the ultrasonic spray pyrolysis (USP) technique. Substrate temperature was kept at 400 ºC. X-ray diffraction (XRD) and photoluminescence (PL) measurements were used to obtain structural and optical properties. The PL emission in the UV bands was observed. Band-edge transitions as well as direct-band transitions for ZnO at around 380 nm (3.26 eV) are observed. For these films, the hexagonal wurtzite structure of ZnO seems to be protected. But (002) peak intensities are varied. C-f measurements were carried out using LRC meter (5Hz- 2MHz) as a function of temperature in the range of 133-300K.

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CT30

Field Effect Transistors Based on Metal-Insulator Transition in VO_2

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[keywords] Vanadium dioxide, metal-insulator transition, field effect transistor (FET), magnetron sputtering

Vanadium dioxide (VO_2) which is one of transition-metal oxides exhibits metal-insulator phase transition (MIT). The transition takes place at nearly 68 ºC [1]. VO_2 has monoclinic crystal structure with its insulator phase whereas it has tetragonal rutile crystal structure with its metallic phase above the MIT temperature (T_{MIT}). The resistivity of VO_2 abruptly changes by an order of four at T_{MIT}. In addition, the optical properties of material in near-infrared region change as depending on the temperature. Due to the change in electrical and optical properties of VO_2, it is an interesting candidate for exploring potential applications. VO_2 might play an important role on not only field effect transistors (FETs) as a channel [1], also the other devices including, micro muscles [2], tunable capacitors [3] and smart windows [4]. In this work, high quality VO_2 thin films have been deposited on c-Al_2O_3 substrate by dc magnetron sputtering technique. Temperature, oxygen concentration and deposition pressure were optimized for single phase VO_2 films which show 10^4 order of MIT. During deposition, the substrate temperature was kept constant at 550 ºC to obtain a good crystal structure. In order to determine structural, optical and electrical properties of grown films, various analyses carried out at different temperatures which are between 25 and 100 ºC. MIT in VO_2 was observed with the change in resistivity by a factor of 10^4 which is the highest value among the grown VO_2 films in the literature. Then, VO_2 films were shaped with various strip thickness by electron beam lithography (EBL) in order to create channel in FET. As gate dielectric, high-k HfO_2 was grown on VO_2 strip by dc magnetron sputtering technique. The refractive index of grown HfO_2 films was determined from the measurement taken by using Spectroscopic Ellipsometer. After that, gold was evaporated as gate and source-drain in order to apply electric field. After completed FET layers, electrical measurement carried out depending on applied voltage and temperature.

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CT31

Structural, Optical, Electrical and Gas Sensing Properties of Yb-doped ZnO Films

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[keywords] Yb doped ZnO, Sol–gel, Structure, Optical properties, NO_2 sensing

Preparation, growth, structure, optical, electrical and gas sensing properties of Yb doped ZnO thin films were studied. $Zn_{1-x}Yb_xO$ (x=0.0, 0.01, 0.02, 0.04, and 0.05) precursor solutions were prepared by sol-gel synthesis using Zn and Yb based alkoxide which were dissolved into solvent and chelating agent [1-2]. $Zn_{1-x}Yb_xO$ thin films with different thickness were produced on glass substrate using sol-gel dip coating. $Zn_{1-x}Yb_xO$ thin films were annealed at various temperatures and times, were tried to observe the doping ratio, temperature, time and thin films effect on structural, optical, electrical and gas sensing properties. The surface morphologies and microstructure of all samples were investigated by SEM, AFM and XRD. The surface morphology of the $Zn_{1-x}Yb_xO$ films depend on substrate nature and sol-gel parameters such as withdrawal speed, drying, heat treatment, deep number (film thickness) and annealing condition [1]. Optical transmittance spectra of the Yb-doped ZnO films were analyzed at room temperature by using a UV-NIR (Shimadzu-2101 PC). The electrical properties of Yb-doped ZnO were considered within wide temperature range from 20 to 200 ºC under the high purity nitrogen (N_2) flow and in the frequency range from 40 Hz to 1 MHz. The effect of the gasses on the conductivity of the thin films was measured in a hand made chamber and high purity N_2 was used as carrier gas at the temperatures of 150 and 200 ºC.

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CT32

Low Dimensional Multilayered Nanostructures for Plasmonic Applications

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[keywords] plasmonics, coaxial, nanowires, atomic layer deposition.

Optical properties of materials can be enhanced by tailoring their plasmonic properties. Plasmons are collective electron oscillations inside metals that can be coupled with light. Forming surface plasmon polaritons, this coupling creates strong optical and electrical fields within nanostructures. Plasmon resonance frequency is affected by intrinsic and morphological features of nanostructures [1]; therefore, design holds great importance. Since they support the production of complex hybridized resonances [2], 1D coaxial nanowires of several metal-dielectric layers and 0D multi-shell metal-dielectric nanoparticles are promising in this manner. In addition, noble metals are generally preferred for plasmonic applications since their resonance frequency is in the visible and near-IR region. Scattering peaks of multilayered nanostructures depend on the thicknesses of the layers, i.e. thin coaxial nanowires exhibit strong plasmon mixing. Thus, dielectric and metal layers should be deposited as thin films. In this study atomic layer deposition (ALD) technique is used to fabricate coaxial nanowires. ALD is an important thin film deposition technique consisting of sequential surface reactions. Due to its self-limiting nature it has the best conformality compared to other thin film techniques, especially for high aspect ratio nanostructures [3]. In this work high aspect ratio silver nanowires that are synthesized by polyol process [4] are used as core nanostructures. On core Ag nanowires, oxides of titanium or aluminum are deposited as spacer dielectric layer which is succeeded by silver deposition. As the multilayered low dimensional plasmonic structures bear hybrid plasmon modes due to mixing, some of these modes are found to be subject to very low attenuation, thus long range, and long lifetime. We expect beneficial qualities as light management interfaces from the resultant nanostructures in thin film photovoltaic devices. The material properties and optical characterization of these structures will be discussed in this context.

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Characterization of Different Chemical Polish Treatments for Molecular Beam Epitaxially Grown CdTe Layers

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[keywords] MBE, CdTe, Polish, XPS, Raman, AFM.

Cadmium Telluride (CdTe) – Gallium Arsenide (GaAs) heterostructure is one of the most important material for imaging-sensing systems and solar cells. Producing high purity and crystalline thin films Molecular Beam Epitaxy (MBE) is the most widely used growth technique by depositing controlled single atomic layers in UHV conditions [1, 2]. MBE growth CdTe/GaAs (211)B layers were subjected to different wet chemical polish treatments to quantify the removal of O and Te-O from the surface. To protect the surface from physical damage due to the chemical processes, CdTe crystals were polished by slow etch rate (~ 6 nm/sec.). Atomic force microscopy (AFM) was used to determine as-grown and polished surface morphology and etch rate of chemical solutions. A study of the surface stoichiometry and the chemical composition of the as-grown and polished CdTe (211)B surfaces were carried out by using *ex situ* x-ray photoelectron spectroscopy (XPS). Vibrational phonon modes and surface quality were investigated by using confocal Raman spectroscopy. The selected wet chemical etching solutions were shown to be useful for CdTe (211)B chemical polishing.

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CT34

Silicon/Carbon Hybrid Nanospheres with Yolk-Shell Structure for Lithium Ion Battery Anodes

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Lithium ion batteries are good choice for portable electronic devices such as laptops, mobile phones and hybrid electric vehicles. Because, lithium ion batteries have high energy density, long cycle life, high safety and low cost. Carbon materials such as graphite are widely used as anodes in lithium ion battery applications. However, the theoretical specific capacity of negative electrode material of graphite is (372 mAh/g) the limiting factor for using portable devices. Silicon is one of the most promising alternative material due to its low working potential and highest specific capacity of 4200 mAh/g. However, silicon cannot be used singly, because of its lower conductivity and poor cycling stability during the electrochemical process. Carbon coated silicon is a practical strategy to improve the electrochemical performance of silicon based anodes. The carbon coatings can enhance the electrochemical conductivity as well as buffer the large volume changes of silicon particles to keep the electrode integrity.

In this study, Si-C composites were synthesized a new gradient sol–gel process. Then, the obtained Si-C composites were immersed in 10 wt.% HF aqueous solution at room temperature for 1-3-5 hours to obtain different Yolk-Shell structures. The surface morphology of the produced electrodes was characterized using Field-emission scanning electron microscopy (FESEM), Transmission electron microscopy (TEM) and Energy dispersive spectroscopy (EDS) in order to understand the elemental surface composition of composites. The structures of the composites were characterized using X-ray diffraction (XRD) patterns and Raman spectroscopy. The electrochemical performance of the produced Si-C electrodes was investigated by charge/discharge and cyclic voltammetry tests from 0.05V to 1.5V in CR2016 test cells. The resistances of the cells were investigated using ac impedance technique (EIS). This study proved that Si-C nanocomposites remarkably increase the discharge capacity of the Li-Ion Batteries.

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Comprehensive investigation of GaAs thermal deoxidation under In overpressure for II-VI layer growth by MBE

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[keywords] GaAs, CdTe, Thermal deoxidation, MBE.

The structural, optical, and electronic properties of group II-VI based alloy semiconductors make them highly desirable for photodetector, solar cell, and luminescent applications. Additionally, band gap of II-VI based alloy semiconductors can be tuned by controlling the composition in ternary or quaternary alloys. High quality thin films of II-VI based alloy semiconductors are mostly grown on substrates such as GaAs and Si with modern crystal growth techniques which are molecular beam epitaxy (MBE), metalorganic vapor phase epitaxy, metal chemical vapor deposition, chemical beam epitaxy, and hot wall epitaxy. Surface morphology and crystal quality of II-VI alloy layers are greatly effected by substrate preparation, growth, and annealing conditions. Surface preparation of GaAs wafers is applied in two steps which are chemical treatment and thermal deoxidation prior to growth in vacuum chambers. Conventionally, thermal deoxidation is performed under As overpressure which leaves surface rich with the Ga-related pits[1,2]. It has been already shown that In assisted thermal deoxidation creates smoother surface with neutral surface skewness[3,4] compared to thermal deoxidation under As overpressure. In this study, we have comprehensively investigated thermal deoxidation of GaAs(211)B wafers under In overpressure prior to growth of II-VI alloy layers. Reflection high energy electron diffraction (RHEED) was used to monitor and analyze surface structure while spectroscopic ellipsometry (SE) was employed to investigate optical properties of GaAs wafers before, during, and after deoxidation process. Surface morphology of deoxidized samples was studied with *ex situ* atomic force microscopy (AFM) while surface states and stoichiometry of deoxidized samples was determined with x-ray photoelectron spectroscopy (XPS). Additionally, CdTe layers were grown on thermally deoxidized GaAs wafers under different deoxidation conditions in order to determine surface preparation effects to epitaxial II-VI layer growth. Crystal quality of CdTe layers were determined with high resolution four-crystal x-ray diffraction (XRD).

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CT36

Effect of rapid thermal annealing on minority carrier measurements and surface recombuination velocity in CZ-silicon p-type wafers

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We have investigated the effect of Rapid Thermal Annealing (RTA) on effective minority carrier lifetime (τ_{eff}) and surface recombination velocity (SRV) in Czochralski (Cz) silicon p-type substrate. Wafers were undergoes RTA annealing with different peaks from 600 °C to 1000 °C. The Quasi-steady state photoconductance (QSSPC) technique are used to measure τ_{eff} to evaluate the impact of RTA annealing on τ_{eff}. A degradation of the carrier life time were observed and the τ_{eff} values drop from 270 µsec in the reference samples to 4 µsec after RTA cycle with 1000 °C peak. Also the maximum injection level of the carrier density (MCD) decrease from $4x10^{16}$ cm^{-3} to $5x10^{14}$ cm^{-3} and the calculated SRV rise from 23 $s.cm^{-1}$ to 10^3 $s.cm^{-1}$ for the Cz-Si wafer with 1000 °C peak temperature. Using the experimental data of τ_{eff} and the theoretical model of the apparent lifetime, we have observed that the recombination center density (Nr) increase from $1x10^{12}$ cm^{-3} to $6.7x10^{12}$ cm^{-3}. During RTA cycle at higher temperature peaks the recombination centers related to the transition metals like Fe and Cr and other traps related to the Boron-Oxygen (B-O) metastable defects are activated leading to the increase of Nr. Optical microscopy is used to observe the structural surface alteration due to the absorption of a high energy during illumination for a short time. Fourier Transform Infrared Spectroscopy (FTIR) technique show a high concentration of the interstitial oxygen (Oi) at 900 °C and 1000 °C peaks at 1107 cm^{-1} wave number indicating the dissolution of the oxygen precipitates in the silicon bulk.

Keywords: Cz Silicon, Rapid Thermal Annealing, Carrier Lifetime degradation, Recombination, traps.

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Graphene Integrated Terahertz Fishnet based Metamaterial Comprised of Hexagonal Resonators for Tunability and Sensing Applications

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[Keywords] fishnet, graphene integrated metamaterials, sensor applications, tunability

A great harmony between metamaterial and graphene to exploit metamaterial-graphene resonances for unusual optical properties not seen in nature has gained a great importance for electromagnetic research and engineering, particularly in THz region [1]. Since THz science is a relatively new field of study, new structures and materials are needed to be discovered. Recently, graphene material has drawn a significant attention not only because it is the thinnest (2D) nanomaterial in the nature but also its perfect electrical and optical transparency properties [2]. In this work, a fishnet metamaterial (MTM) based on complementary hexagonal resonator modified by using graphene material in sub-THz frequencies is examined. The hexagonal metal layers are created and assigned as gold on a dielectric substrate. The smaller hexagonal structures are created and removed from both of the metal layers to obtain fishnet MTM. In order to improve S parameters, graphene material is converted to the sheet form to cover the metal layer and dielectric substrate separately. Graphene is selected to cover the composite fishnet MTM designs since it has some unique properties such as high electron mobility and conductivity [2]. The simulations have been performed by a full wave electromagnetic simulation to obtain the reflection parameter (S_{11}), transmission parameter (S_{21}), permittivity (ε) and permeability (μ) of the composite. The opportunity of tunability of graphene's response by electrostatic doping increases the importance of these kind of structures and the presented fishnet metamaterial structures modified with graphene can effectively be used for tunability and sensor applications [3].

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Microstructural and Mechanical Properties of Spin Coated Titania/Hydroxyapatite Films on Ti6Al4V Substrates

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[keywords] Thin film, titania, hydroxyapatite, spin coating, titanium alloy.

Biocompatible hydroxyapatite (HAp) coatings on load bearing metallic (Ti6Al4V) hard tissue implants act as bone morphogenetic proteins carrier for post operative accelerated healing, and enhance implant durability with the tailored microstructural and mechanical properties. TiO_2 and HAp powder suspensions (15% solid content each) in deionized water or absolute ethanol were used to prepare Ti6Al4V substrate/TiO_2, Ti6Al4V substrate/HAp, and Ti6Al4V substrate/TiO_2/HAp films of thicknesses between 0.5 to 5μm by spin coating followed by heat treatment at 850°C. The XRD patterns of spin coated HAp films on Ti6Al4V pointed out to a particular crystal orientation which would increased the positive degree of cooperativity between HAp and proteins during adsorption and deposition. The orientation indicated by HAp biased peaks at 2θ values of 28.3° of (210) and 25.2° of (002) planes, was brought about by the preferred alignment of rod like shaped grains (grown in one crystal direction during production) on the substrate. The intermediate TiO_2 layer rebonded both to the substrate and the HAp film during heat treatment at 850°C. The tensile test yielded adhesion strength values up to 30 MPa while the scratch test yielded values up to 170 MPa comparable to the commercial plasma spray coating method.

*This research is conducted as part of the Ph.D. thesis of Selçuk Özcan at Izmir Institute of Technology, Department of Chemical Engineering.

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Structural and Electrochemical Study of Ni-Mo Alloy Coatings Electrodeposited at Different Current Densities

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[keywords] Ni-Mo alloy, electrodeposition, corrosion resistance, gum arabic.

The electrodeposition of micrometer sized Ni-Mo alloys was investigated using different values of applied current density at pH 5.5 and T 30 °C. The composition of the coating layer was determined using EDX. The crystalline of electrodeposits was examined using XRD, whereas, the morphology was investigated using MEB. The corrosion resistance of Ni-Mo alloys compared to pure Ni was studied in 3.5 % NaCl solution using potentiodynamic polarization and electrochemical impedance techniques. Ni-Mo alloy electrodeposited at current density 10 A/dm² show the best corrosion resistance compared to other Ni-Mo alloys and pure Ni [1, 2]. however, the addition of gum arabic to the corrosive solution improve the corrosion resistance of both Ni-Mo and pure Ni coatings.

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CT40

Ion beam modification of ZnO epilayers for optoelectronic applications

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[keywords] ZnO epilayers, RE impantation, light emision

The controlled incorporation of rare earth (RE) ions into ZnO is very promising technique for production of optoelectronic devices with emission in the visible spectral range. White light emission can be obtained by addition of three primary RGB colors emitted by ZnO epitaxial layers implanted with selected RE ions. RE doping by ion implantation offers the possibility of controlled doping at required depths and easy lateral pattering. It also suffers less from solubility limits than *in situ* doping techniques. However, because of the ballistic nature it does produce considerable structural damage.

First part of our study was focused on the measurement of defect accumulation curve and the elucidation of defect transformations occurring upon ion implantation. It has been observed that at sufficiently high dose (approx. 2E15 ion/cm^2 for 150 keV RE ions) plastic deformation occurs. The driving force is the increase of shear stress due to the damage accumulation. Once the critical value of stress was attained dislocation slip takes place leading to the formation of dislocations tangle. Such a defect structure cannot be completely removed by thermal annealing. To solve the problem a new method of sequential RE-ion implantation has been developed basing on the stepwise incorporation of high concentration of RE. It consists on low fluence RE ion implantation that is followed by the subsequent annealing. The procedure has to be repeated until the required impurity concentration has been reached. Special care has been taken to optimize the post implantation annealing temperature and time.

Epitaxial ZnO layers were grown using the ALD technique and comprehensive optical, electrical and structural studies using different techniques like: RBS/channeling, TEM, HRXRD and PL were performed. Consequently, the photoluminescence output of RE implanted ZnO epilayers has been maximized.

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Influence of the Sulfurization Time on the Structural, Optical, and Electrical Properties of Cu_2ZnSnS_4 Thin Films

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[keywords] Thin film solar cells, Kesterite, CZTS

Although Cu(In, Ga)Se_2 (CIGS) based thin film solar cells have already reached over 20 % conversion efficiency, inadequacy of In, Ga and toxicity of Se may hinder its mass production and promotion for the future applications in PV. The Cu_2ZnSnS_4 (CZTS) is considered one of the most promising alternative layer in place of CIGS-based thin film solar cells due to comprising earth-abundant elements (Cu, Zn, and Sn) [1], favorable optical band gap (1.4-1.6 eV), and high absorption coefficient ($\geq 10^4$ cm^{-1}) [2]. Although theoretical conversion efficiency of CZTS-based thin film solar cell is estimated around 32.4 % [3], the current record efficiency has been obtained around 12.6 % by IBM research group [4]. Various methods to obtain more efficient solar cells have been investigated in the past. These methods encompass trying different deposition techniques, sulfurization temperatures and times, controlling the composition of the film, etc. In our study, the metallic precursors Cu, Zn, and Sn sequentially deposited on Mo-coated glass. Then, they were annealed in a sulfur atmosphere at high temperature using different dwelling times to obtain complete CZTS structure. In this study, the effect of the shorter dwelling times with respect to literature on the structural, optical, and electrical properties of kesterite CZTS thin film is investigated.

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CT43

Capillary Origami as a New Method for Printing Nanoparticles on 3D Surfaces

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Printing of nanoparticles on surfaces, or nanoimprinting, is an emerging technology where the final goal is to produce smart surfaces that can be used as sensors, flexible electronics or drug delivery tools. These surfaces would be using the unique characteristic of nanomaterials due to their small size and large surface to volume ratio. To our knowledge, until now, there has not been any reported technique of nanoparticle printing on three dimensional surfaces. In this abstract we are introducing the capillary origami as a method to create curved and enclosed surfaces that have printed nanoparticles on them. Wrapping of polymer surfaces around a liquid droplet due to capillary forces was reported previously [1, 2]. Folded polymer surfaces are promising for applications such as drug or microorganism encapsulation and release [3]. By having nanoparticle coating, these surfaces can be made more functional. Self-folded 3D surfaces covered with a thin magnetic nanoparticle layer, can be directed in a magnetic field; which makes this structure to be suitable for targeted drug delivery applications. A droplet on an elastic surface wraps the surface around it as it vaporizes under the effect of surface tension (γ) force. This forms a self-folding thin surface that can be pre-calculated [1]. The surface tension, which causes surface to fold, should overcome the opposing bending stiffness, (expressed as B) to form 3D folded structures. The main equation for the critical length to determine whether the surface will fold or not was previously given by Bico et al. as follows [2]:

$$L_{EC} = (B/\gamma_0)^{1/2} \quad (1)$$

where L_{EC} represents elasto-capillary length and depends on the bending stiffness and the surface tension between the droplet and the surface. The critical length of the surface has to be larger than L_{EC} for the surface to wrap around the droplet [1]. Folding of surfaces by evaporating a distilled water droplet on a thin polymer membrane was first demonstrated by Py et al. [1]. In this method, only a pure water droplet was used and after the evaporation, the structure reopened completely. In this study, we utilize this method to print magnetic nanoparticles on thin PDMS membranes and form 3D folded structures that can be manipulated under a magnetic field. To achieve this, we placed a droplet composed of magnetic Fe_3O_4 nanoparticles dispersed in DI water, on a 15μm thick PDMS square membrane and observed the folding of the surface as the water evaporated through the PDMS. We observed that the 3D structure preserves its shape after the evaporation is complete and the folded structure can be moved in a magnetic field without any shape deformation. The investigation of the particle distribution on the surface and its uniformity will be accomplished by using atomic force microscopy and will be presented at the conference.

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Magnetron Sputtering Growth of AZO/ZnO/ Zn(O,S) Multilayers for Cu_2ZnSnS_4 Thin Film Solar Cells

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[keywords] CZTS thin film solar cell, AZO, ZnO, Zn(O,S)

Cu_2ZnSnS_4 (CZTS) absorber layer attracts so much attention in photovoltaic industry since it contains earth abundant, low cost and non-toxic elements contrary to other chalcogenide based solar cells such as $CuIn(Ga)(S,Se)_2$ (CIGS) and CdTe. Although, CZTS studies have been newly started yet, recently 12.6% efficiency has been achieved [1]. Zinc oxysulfide (Zn(O,S)) is an excellent candidate for a wide band gap buffer layer because its constituent elements can be tuned to give any composition ranging between ZnO and ZnS, hence forming a favorable CBO with various absorber layers [2]. Buffer layers should also be non-toxic and earth abundant in order to be environmentally safe and applicable in low cost production. Owing to its versatility, Zn(O,S) fits all these criteria and is therefore a promising candidate for replacing the conventional CdS as a buffer layer. Generally, indium tin oxide (ITO) is used as a window layer in solar cells. However, due to its high cost and toxic properties, researchers are searching for a better alternative for the same. In this regard, Aluminum doped zinc oxide (AZO) is considered to be an alternative because it is a low cost material having a high band gap, non-toxic in nature, and high transparency [3] .

In this work sequentially deposited Cu-Zn-Sn thin film layers on Ti metallic foils using the magnetron sputtering technique were annealed in an Ar + S_2(g) atmosphere [4]. The optical band gap energy value, E_g, was determined as 1.52 eV for CZTS films. In RAMAN plots of all samples nearly pure kesterite CZTS structure's vibration modes are clearly depicted. Additionally, the intense and sharp XRD diffraction peak from the (112) plane provided evidence of good crystallinity. Moreover, optimum growth parameters for magnetron sputtered Zn(O,S), ZnO and AZO layers were determined. The films were characterized by X-ray diffraction (XRD), optical transmission, Raman measurements and X-ray photoelectron spectroscopy (XPS). For Zn(O,S) buffer layer, we observed that key parameters like band gap of the Zn(O,S) layers can be precisely tuned by varying the oxygen content,. For AZO window layer, we used rotating holder which has the same center with the sputtering chamber. SLG substrates were placed to the sample holder with different distances from the target. In this way, we investigate the effect of deposition angle, distance from the target and rotation speed. We observed sharp decrease in the resistivity when the distance between substrate and target increases.

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XPS Analysis and Structural Characterization of Cu_2ZnSnS_4 (CZTS) Absorbers on Flexible Ti Foils

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[keywords] CZTS, thin film solar cell, flexible substrate.

The quaternary compound of Cu_2ZnSnS_4 (CZTS) is a newly explored semiconductor photovoltaic material which is expected to be interesting for thin-film solar cell absorber. CZTS consists of Cu, Zn, Sn and S, which are fairly low cost, earth-abundant and environmentally friendly elements. Because of these advantages, CZTS is seen as a future replacement for $CuInGaSe_2$ (CIGS) solar cells in photovoltaic (PV) industry. The CZTS thin films show p-type conductivity, high absorption coefficient (10^4 cm^{-1}) and a band gap of 1.45-1.5 eV that is ideal to achieve the highest solar-cell conversion efficiency [1]. It is currently reported that the highest efficiency for the CZTS based thin film solar cells is 12.6% which demanding further improvement [2]. The development of high efficiency Cu_2ZnSnS_4 (CZTS) thin film solar cells depends on the synthesis of phase pure CZTS absorbers. Due to the difficulties of preparation pure phase CZTS films (i.e., a film lack of secondary phases), the structural and compositional properties of CZTS films must be systematically studied. In the current study, CZTS absorber films are prepared by two independent stages. CZT precursors are grown on the Ti foil or soda-lime glass substrates with deposition order from top to bottom Cu/Sn/Zn by using DC magnetron sputtering technique. The deposited precursors are sulfurized inside a graphite box with different sulfurization temperatures by using sulfur powder. For the structural characterizations, the Raman Spectroscopy, X-Ray Diffraction (XRD) and Scanning Electron Microscopy (SEM) are used. The atomic compositional ratio are studied using Energy Dispersive X-ray Spectroscopy (EDX) and X-Ray photoelectron spectroscopy (XPS) quantitive analysis. The effect of various sulfurization, pre and post annealing temperatures on the film's structures will be examined. The stoichiometry of CZTS films will also be discussed for high efficiency thin film solar cells.

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Surface Coverage Control of Self Organized Plasmonic Interfaces for Photovoltaics

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[keywords] plasmonics, spray coating, nanoparticles

Light management in thin-film photovoltaic devices can be realized by plasmonic interfaces. Self-organized fabrication is a very suitable strategy for production of large area plasmonic interface [1]. However, the typical surface coverage of plasmonic structures lies around 25-35% on interfaces produced by this technique. This is too high with respect to the ideal value of 10% for the optimum light management [2]. In this work new self-organized strategies for control of surface coverage at a level of 10% will be developed. As an example, Ag nanowires or nanoparticles synthesized as colloidal solutions will be applied to coat photovoltaic related materials in a controlled amount. After the coating step, plasmonic interfaces will be produced by thermal treatment of these materials or surfaces in a self-organized manner. After the production of targeted plasmonic interfaces, their light management properties will be characterized [3-4]. The characterization is performed using scanning electron microscopy (SEM), reflection and angle-resolved scattering spectral measurements.

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Inorganic-Organic Layered Coatings to Obtain Electrochromic Fiber

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[keywords] Electrochromism, Electrochromic Fiber, Oxidative Polymerization.

Electrochromism—the alteration of absorption/color by electrochemically induced redox reactions—is a property shared by several electroactive species including inorganic transition metal oxides, hexacyanometallates, viologens and conjugated polymers. Electrochromic materials consists of layered coatings. A typical example can be five to seven layers. As a principle, on electrochromic devices, a newly layer is created by coating an electrochromic conductive polymer on the surface of hard layer. The electric potential is provided via this conductive layer. This conductive layer is coated again with an electrochromic material after coated on the top with an electrolyte material which separates its ions and the sandwich construction is completed with coating usually indium tin oxide (In_2O_3, ITO) as a conductive and transparent material. The color change occuring in the polymer, depending on the potential difference which is given to the conductive layers, the degree of oxidation and reduction reactions during passing electrochromic polymer material through.

In this study, the aim was to obtain electrochromic textile structure by forming electrochromic structure on the textile fiber. To form electrochromic structure polyamide (PA) fiber was used. Towards this aim, a system was created that allows continuous process flow in order to coat the fibers by wet chemical methods after initially coating them by plasma (magnetron sputtering) with indium tin oxide (ITO). Hence, PEDOT, polypyrrolle were used as conjugated polymer, ITO was used as conductive material, as the metal oxide as well. In this study, magnetic sputtering method was applied for ITO coating, chemical oxidative polymerization method (sol-gel) was for the coating of conductive polymers. To obtain electrochromic structure, firstly PA fibers was coated by ITO by magnetron sputtering and then by PEDOT by chemical oxidative polymerization. In this chemical oxidation oxidant agent and organic solvent was studied to find the most suitable formula. The third layer was gel electrolyte prepared by PEMA, PVC, PC and $LiClO_4$. The fourth layer was polypyrrole and the last layer was again ITO by magnetron sputtering. FTIR-ATR and SEM were applied for the characterization of chemical coatings on the fibers and for the characterization of the film morpholog, respectively. Conductivity properties of the fibers measured by electrochemical impedance spectroscopy (EIS).

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Low Cost Infrared Photodiodes Based on Chalcogen Hyperdoped Black Silicon

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[keywords] Black silicon, infrared, NIR, MWIR, LWIR, pulsed laser melting, responsivity.

Black silicon photodetectors are another variation of silicon photodetectors are known that able to sense the visible light. The material is called “Black silicon” because the silicon surface has a unique surface geometry which is non-reflective and highly absorptive [1]. Their applications in silicon devices, predominantly in photovoltaics is known that the black silicon photodetectors have good responsivity values in visible [2] and near infrared (NIR) regions [3]. Hypersaturated solid solutions of chalcogen in silicon were fabricated by ion implantation followed by nanosecond pulsed laser melting. The optical absorptance is ~100% in 0.7 – 2.5 μm and ~90% between 2.5 – 25 μm wavelengths respectively. Hypersaturated black silicon photodiodes produced from these materials also shows high quantum efficiency at room temperature and at the lower temperature (80 K) shows extremely broad spectral response (in NIR, mid-wave infrared –MWIR and long-wave infrared – LWIR) which makes the black silicon also applicable in low-cost IR technology.

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ii. The samples were implanted in Ion Beam Center (IBC) – Helmholtz Zentrum Dresden-Rossendorf (HZDR), Dresden, Germany.
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CT49

Growth and Investigation of Structural, Optical and Electrical Properties of PbS Thin Films

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[keywords] PbS thin films, ultrasonic spray pyrolysis, structural, optical, electrical properties

Semiconductor materials which have narrow and direct band gap are well accepted to use in sensing devices and solar cells. From this aspect lead sulphide (PbS) thin films are promising materials because of their small and direct band gap in bulk form (0.4 eV at 300 K) and relatively large exciton Bohr radius (~18 nm) [1]. Furthermore, relatively large exciton Bohr radius originates the quantum size effect and thus it allows tuning the band gap by adjusting crystallite size [2]. Especially, in terms of obtaining the material with the band gap which is in accordance with the solar spectrum, this phenomenon gives rise to use in PbS thin films for absorber layer in solar cell. Additionally, depending on the sulfur concentration in materials PbS thin films exhibit both n-type and p-type electrical conductivity. Lead rich materials have n-type conductivity while sulfur rich materials have p-type conductivity [3].

In this work, PbS thin films were deposited onto glass substrate by ultrasonic spray pyrolysis system at substrate temperature of 225 °C. Precursor solution were prepared by dissolving lead acetate and thiourea chemical salts in distilled water. In order to investigate Pb-S rate effect on physical properties of PbS thin films, in precursor solution Pb molarities were fixed as 0.05M and S molarities were chosen as 0.05, 0.075, 0.1 and 0.125 M for named as E5-0, E5-1, E5-2 and E5-3 films, respectively. Structural properties were evaluated by using XRD patterns and crystallite size and lattice parameters were calculated. Optical band gap, Urbach parameter and optical properties were determined by using transmittance and absorbance spectra taken UV-Vis spectrophotometer. Electrical properties were examined by I-V curves using two probe technique.

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CT50

Influence of Sulphurization Time on the Properties of Cu_2ZnSnS_4 Thin Films Deposited on Mo-coated SLG Substrates by Co-sputtering

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[keywords] CZTS, thin film, solar cell, co-sputtering, sulphurization

Kesterite-type Cu_2ZnSnS_4 (CZTS) is a quaternary semiconductor compound which contains earth-abundant and environmentally friendly elements. As an absorber layer for low-cost thin film solar cells, CZTS is a promising material with its suitable direct bandgap in the range of 1,4-1,5 eV and a high absorption coefficient above 10^4 cm^{-1}[1]. According to Shockley-Queisser limit, it is possible to reach an efficiency of % 32 with a single junction solar cell made up of absorber layers having 1.5 eV bandgap [3].

In this study, a two-step approach was used for the synthesis of CZTS thin film absorbers. In first step, CZTS precursor film was deposited on Mo-coated soda lime glass (SLG) substrates by using co-sputtering of Cu (DC), Sn (RF) and ZnS (RF) targets at room temperature in an argon atmosphere with a base pressure of ~10^{-7} Torr. The DC sputtering power of Cu and RF sputtering powers of Sn, ZnS targets were fixed at 95 W, 20 W and 150 W respectively, with a 30 mTorr working pressure. In the second step, the precursor films were sulphurized and crystallized in a two-zoned diffusion furnace and then the films were let being cooled naturally in the furnace. The sulphurization process was carried out by heating 0,5 g powder sulphur to 350 °C and the precursor film to 550 °C in different zones of the furnace. Both zones of the furnace reached to determined temperatures at the same time with slow heating and then the sulphurization process was made for four different samples at different periods of 10-15-20-25 minutes. The thicknesses of the precursor film and sulphurized films were determined as ~1,6 µm and ~1,8 µm, respectively by profilometer measurement. To find out the effect of sulphurization time on the properties of the films, the structural, electrical and optical properties of CZTS thin films were investigated. The crystal structure of CZTS thin film layers was identified by X-ray diffraction (XRD) technique and then the formation of the kesterite-CZTS was confirmed by Raman Spectroscopy. The surface morphology of the films were observed by Atomic Force Microscopy (AFM) and Scanning Electron Microscopy (SEM) analysis. Electrical properties of the films were also determined by Hall Effect measurement system. Optical properties of the CZTS films were measured using UV-Vis Spectroscopy and the band gap was obtained as ~1,4 eV by extrapolating the linear portion of the curve to the x-axis. In addition, diffused sodium concentrations into the CZTS absorber layer from SLG substrate were investigated by secondary ion mass spectroscopy (SIMS) depth profile measurement in detail.

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CT51

High-T_c Superconducting Materials Based Sources, Detectors and Filters for Terahertz Applications

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There is a growing interest on technology of electromagnetic waves in terahertz frequency region (0.3-10 THz) due to their variety of application areas in the physical, astronomical, medical and biological sciences, including imaging, spectroscopy, information technology, medical diagnosis and the detection of explosives [1]. In the desired regime, devices fabricated from $Bi_2Sr_2CaCu_2O_{8+\delta}$ (Bi2212) high-T_c superconductors are promising candidates for detection and emission purpose. While there is a high motivation to perform experiments in the THz frequency range, new sources, detectors and optical components are still needed. Recently, there have been many improvements in the development of THz sources [2-3] and in the fabrication of THz detectors. Moreover, many efforts to develop tunable THz filters have been impeded. We investigated various experimental techniques to fabricate THz sources, bolometers and filters for efficient THz emission and detection. Rectangular mesa structures were fabricated on Bi2212 single crystal superconductors using standard e-beam lithography and Ar ion beam etching systems. An emitted power as high as 0.06 mW was detected from Bi2212 mesa structures. In addition to this, we have designed microbolometer chip fabricated from high temperature superconducting Bi2212 single crystals for the THz detection. Bi2212 single crystals were transferred on substrate in the thin film like form and electron beam lithography, ion beam etching techniques were used. Bi2212 microchips were integrated and characterized using in our compact cryogenic bolometer system. The detection properties and sensitivity of microbolometer chips can be further improved by integrating an antenna and filter structures. Since, we have fabricated (THz) bandpass filters from titanium, copper and indium tin oxide thin films on fused silica substrates by UV lithography with an array of cross-shaped apertures. Design of the filter structures was created by CST microwave studio program. We were able to reveal the performance of these filters experimentally using both a THz time domain spectrometer and a Fourier transform infrared spectrometer (FTIR).

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CT52

Electrical Performance of InAs/GaSb Type-II Superlattices

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[keywords] Type-II superlattice, infrared photodetector, capacitance.

InAs/GaSb Type-II superlattice (T2SL) photodetectors are promising for mid-wavelength infrared (MWIR) and long-wavelength infrared (LWIR) detection applications. Since they were first proposed by Sai- Halasz et al [1], T2SL detectors have been investigated by several groups. Despite the suppressed Auger recombination [2] and feasibility for high temperature operation [3], T2SL detectors have not showed their theoretically expected potentials yet. Performance of minority carrier devices are greatly associated with residual background carrier concentration. For this reason, carrier concentration in nonintentionally doped (nid) region affects the electrical and optical performance of T2SL p-i-n diodes; therefore, it is critical to know both the type and the level of carriers in i-region. It was previously reported that keeping GaSb thickness constant at 7 monolayers (ML) and increasing InAs thickness from 7 MLs to 13 MLs caused residual background type change from p-type to n-type [4]. In this study, we investigated the influence of the interface thickness and variable InAs, GaSb layer thicknesses on residual background carrier concentration MWIR T2SL by using capacitance-voltage (C-V) measurements. Frequency and voltage dependent capacitance measurements were carried out at different temperatures and the results were discussed comparatively. We also investigated the activation energies of these T2SL structures using both temperature dependent C-V and current-voltage measurements.

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Cross like Terahertz Metamaterial Absorber for Sensing Applications

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[keywords] metamaterial, absorber, sensor, multiband, terahertz waves.

The devices engineered for the utilization of the terahertz region of the electromagnetic spectrum (so called terahertz gap) are taking great interest. This is mainly because of the potential application in imaging, sensing and absorber in this region. Metamaterials which are artificially designed materials with the geometric scales smaller than the wavelength of incoming electromagnetic waves, can be used to utilize terahertz region. The geometry of metamaterials can be modified so that a specific electromagnetic response can be obtained at a certain frequency. These materials can be used for the sensing, imaging, absorber applications with different characteristics like polarization, multiband or wideband.

In this work, a new multiband terahertz metamaterial absorber is developed and characterized by numerical simulation method. In addition, the utilization of the proposed absorber as a sensor is also investigated. According to the results the proposed multiband metamaterial absorber has the ability for the utilization of the terahertz region between 1.5 THz and 2 THz. Moreover, due to the four-folded symmetric characteristics of the design, mentioned absorber works independent from the polarization of the incoming electromagnetic wave.

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CT54

Tunable Band Pass Metamaterial Filters Based on YBCO Superconductors in Terahertz Range

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[Keywords] Terahertz Radiation, Metamaterials, Band Pass Filters.

Terahertz (THz) frequency band has incomparable advantages involving a non-ionizing bio-innocuous property, transparent characteristics in cardboard or textiles, and highly selective absorption spectral lines that can serve as a “genetic code” of various bio-materials [1]. These superiorities lead to various important potential applications, such as bio-medical imaging, chemistry, ultra-wideband wireless communications, and chemical sensors. On the other hand, the non-existence of high-performance THz devices prevents the construction of frequency-agile THz systems [2-3]. Metamaterial-based devices have been investigated in order to control the THz frequency signal. Specifically, for frequency-selective filters and modulators, metamaterials based on split ring resonators are frequently exploited. In this study, we develop narrow band THz band-pass filters based on metallic and superconducting metamaterials. Since Au, Cr and Cu have good attachment to the substrate, they were chosen as the metallic layer. Using high vacuum magnetron sputtering system we have grown these films. Terahertz resonant filters were lithographically fabricated from 150-300 nm metal films grown on 1 mm thick quartz substrates and $YBa_2Cu_3O_y$ (YBCO) thin films. Preceding the fabrication process, we have measured the samples with a Bruker Vertex V80 FTIR spectrometer. After the transmission measurements we have observed center frequencies and bandwidths close to the design predictions. Ultimately, we have characterized the created structures by time-domain THz spectroscopy (THz-TDS) and CW-THz measurement systems. For the simulation studies of transmittance properties of filter structures (Fig. 1), we have used CST microwave studio and the obtained data is compared with experimental results.

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CT55

Role of Surface Oxidation on Deformation of Iron Nanowires: Reactive Molecular Dynamics Simulation Using ReaxFF

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Generally, a surface oxide layer has been known to have significant effect on the mechanical behaviors of metallic NWs [1]. In spite of its importance, the influence of oxidation on the mechanical properties of nanostructured metals is rarely explored and remains mysterious [2]. In particular, it still remains difficult to quantify the effect of the oxide independently on the tensile mechanical deformation behavior and on the properties of the Fe NWs [2]. For this reason, we investigate systematically the correlations and effects of oxide layer on the mechanical deformation performance of Fe NWs, calculate related properties with and without surface oxide defect, and furthermore discuss plastic yielding behavior and kinetics under a tensile loading. We use molecular dynamics (MD) simulation with proper treatment of dynamic charge transfer by using the ReaxFF potential, in where quantum-mechanical descriptions of chemical reactions are handled accurately [3]. Our results demonstrate that the unique features of oxide shell layers have direct effects on the elastic mechanical properties of the cylindrical metallic Fe NWs. Reduction in the elastic strength of the pure Fe NW, the Young's modulus, yield strain, yield strengths, maximum strength and strain of the Fe NWs, significantly sensitive to the oxide layer. Our MD simulations shows that the nucleation and propagation of twinning is the only major cause in the mechanical deformation mechanism for both pure and oxide Fe NWs in the plastically deformed region but twin nucleation is occurred in the low strain level for the oxide layers Fe NWs. The oxide defect shell layer may act as a productive source of dislocations, hence, reducing the onset of the plastic deformation. The oxide Fe NWs plastic deformation starts easily as compared to the pure Fe NW, and thus, comparatively a low flow stress is sufficient enough for all Fe NWs plastic deformations to continue in a ductile manner at remaining average constant stress levels beyond a maximum stress through twinning. The formation, growth and propagation of twins in the pure and oxide Fe NWs are qualitatively quite similar regardless of oxide: require the large initial maximum stress to nucleate the partial dislocation and follow by twinning migration with a lower stress. Our study will be practically helpful for understanding mechanochemical tensile deformation process and related properties of the Fe NWs as a function of oxide layer.

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CT56

Design and Characterization of Continuous Wave Terahertz Imaging System

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Terahertz (THz) frequency region (0.3-10 THz) is the unexplored region of the electromagnetic spectrum and has a growing importance due to their variety of possible application areas such as defense security and the health sector. Their ability to pass through clothing, packaging materials such as fabrics, plastics, and cardboard, to reflect from metal and to absorbed by water host significant potential applications including shopping center and airport security [1]. Therefore, it makes easy the distinction of these chemicals from the other harmless substances by spectroscopic methods.

THz imaging system are classified into 2 categories active imaging as an imaging and spectroscopy and passive imaging as incoherent (heterodyne) imaging. Active imaging further classified into 2 categories such as pulsed and continuous wave imaging. All objects emit thermal (black-body) radiation. Passive imagers work by detecting this radiation. Images are formed through contrasts between differences in material emissivity. For the active imaging, an external pulsed or continuous waves comes toward the object and coming waves scattered, reflected or transmitted from the object and then detected. In the CW THz imaging, mostly transmission imaging is used and only the intensity of the wave changes.

Designed Continuous wave THz imaging system consist of Synthesizer and YIG Oscillator as a signal generator (<20 GHz), VDI WR1.5 AMC (Amplifier/Multiplier Chain), which completely covers 500-750 GHz frequency band, frequency counter, four off-axis 90° parabolic mirrors, room temperature detector “Golay Cell”, and XY scanning stage. The beam diameter were determined by knif-edge method and we found it 1.7 mm. It is also compatible with the calculated value “1.66 mm”. THz imaging of metal blade, screw, metal holder of paper clip and a peace of plastic concealed behind the carton paper and wires in the corrugated paper were taken. For the future work, VO_2 and ITO thin film characterizations will be done.

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Fabrication and Characterization of DC Sputtered VO_x:Au THz Bolometer

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[keywords] vanadium oxide, terahertz bolometer.

Terahertz (THz) waves have been studied in many different fields and technological improvements in nanotechnology and photonics expand the range of THz applications. Although THz technology is growing rapidly in many areas including biomedical imaging, explosive, hazardous substances identification and wireless communication, security applications are needed more than ever before. These applications require powerful sources and we have shown that intrinsic Josephson junctions of superconducting crystal could be used as powerful THz source [1,2]. On the other hand, fast, sensitive and room temperature operating detectors are also needed. Amorphous silicon and vanadium oxides have been widely used for infrared uncooled detector industry [3]. Vanadium is a transition metal that has several stable oxide phases. These stable oxide phases can exhibit most desired properties for bolometer applications such as high temperature coefficient of resistivity (TCR), low resistivity and low 1/f noise. Moreover low cost manufacturing and acceptable performance values make them perfect candidate for detector technologies. In this study, high resistivity silicon (HRSi) wafers were chosen as substrate due to their easy fabrication, low lost and high transmission characteristics at THz region. Vanadium oxide (VOx) thin films were sputtered by dc magnetron sputtering system at room temperature. Fabrication of these films with desired characteristics is very difficult hence their sputtering and post annealing conditions must be optimized carefully. Although optimized VOx films properties satisfy most of the bolometer requirements, high Johnson noise caused by resistive heating restrict their usage at THz region. It is shown that the resistance in amorphous vanadium oxide thin films could be reduced with metal doping such as gold [4] and hence it is a good candidate for IR detectors. In order to obtain optimum characteristics for THz bolometer applications, we doped our VOx thin films with different Au doping conditions and performed different post annealing process. Temperature dependence of resistance from 20 to 85 °C was measured using microprobe station for each film and related TCR values were calculated. E-beam lithography and chemical etch were used to obtain VOx:Au bridges for sensitive and fast detection properties. Detector characteristics such as response time, detectivity and noise equivalent power were investigated.

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CT58

Optical Properties of $CuSbS_2$ Thin Films

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[keywords] Optical properties, hot injection, nanocrystals, $CuSbS_2$

In this study, we present the growth of nanocrystals $CuSbS_2$ produced via hot injection method and their thin films applications successfully prepared on glass substrates by spin coating techniques. The $CuSbS_2$ nanocrystals were synthesized by hot-injection method. In-depth characterization has indicated that pure stoichiometric $CuSbS_2$ nanocrystals with an average particle size mostly distributed between 15 and 20 nm have been formed. We have analyzed the optical transmission and reflection spectra of nanocrystal $CuSbS_2$ thin film between 250-2000 nm wavelength range. Optical band gap has been determined by standard optical analysis and also several optical parameter such as refractive index, extinction coefficient nanocrystals $CuSbS_2$ has been shown to be a potential application for sustainable thin-film solar cell devices.

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POSTER SESSION A

PA001

Anodic Formation of Nanoporous Crystalline Niobium Oxide

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Keywords: Oxidation; Anodic film; Niobium; HF; Crystallization.

Now the increasing attention is paid to creation and studying of the material properties having nanometer structure. Anodic oxidation of valve metals(Al, Ti, Nb, Ta)is widely used for formation of nanostructured oxide films. As it is known, self-organization of nanoporous structures at electrochemical processing is revealed most brightly during formation of porous anodic oxides of aluminum and titanium. They are distinguished with high degree ofsequence in the arrangement of pores and the possibility to operate the variation of the surface morphology and thickness of the oxide film in the wide range.The anodic niobium oxide received in the fluoride-containing electrolytes, significantly differs from porous oxide of aluminum and titanium dioxide nanotubes. Under certain conditions of anodization, anodic oxide films (AOF) Nb_2O_5 are formed with the crystalline structure in the form of microcones . This circumstance causes common use of similar layers in the various devices and designs, for example, in electric capacitors and electrochromic devices , and also in thin-film lithium ion battery and so forth. The researchers' views on the mechanism of nucleation and formation of crystalline structure of porous AOF niobium have inconsistent character. Therefore, it is noted that formation of crystalline phase takes place under the influence of the internal tension that arise with a growth of oxide thickness. It is supposed that formation of niobium oxide microcones has to be connected with nonuniform chemical dissolution of the anodic film during anodization.From our point of view, it is necessary to consider the chemical nature of niobium that belongs to d-type elements for understanding of the nucleation and growth of crystalline phase mechanism. After one electron has been released, it turns into an ion having unfinished d-levels as external. Thereof the formed ion tries to get a stable electronic configuration, especially with oxygen and other nonmetals. It is the existence of incomplete configurations of d-electrons which causes niobium to display a wide set of the valence states. The possibility of their existence is proved by thermodynamic calculations it is also shown that low oxides have to be on metal/high oxide boundary. The transition zone cannot be considered as a certain plane-parallel layer between metal and the high oxide. Local inhomogeneity on metal surface, the border of grains, dislocation, admixture atoms and other, structural and chemical defects are considered to be the centers of increased surface energy. At these centers oxygen diffusion into metal is simplified and the primary formation of the lowest valence oxides is possible exactly here.As it was shown that films generated in potassium nitrate melt instead of being entire niobium pentoxide layer, as it was seemed to be, has occurred to be a «sandwich» of Nb_2O_5, NbO_2 and NbO phases (in the direction from oxide surface to niobium.

PA002

Surface Coverage Control of Self Organized Plasmonic Interfaces for Photovoltaics

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[keywords] plasmonics, spray coating, nanoparticles

Light management in thin-film photovoltaic devices can be realized by plasmonic interfaces. Self-organized fabrication is a very suitable strategy for production of large area plasmonic interface [1]. However, the typical surface coverage of plasmonic structures lies around 25-35% on interfaces produced by this technique. This is too high with respect to the ideal value of 10% for the optimum light management [2]. In this work new self-organized strategies for control of surface coverage at a level of 10% will be developed. As an example, Ag nanowires or nanoparticles synthesized as colloidal solutions will be applied to coat photovoltaic related materials in a controlled amount. After the coating step, plasmonic interfaces will be produced by thermal treatment of these materials or surfaces in a self-organized manner. After the production of targeted plasmonic interfaces, their light management properties will be characterized [3-4]. The characterization is performed using scanning electron microscopy (SEM), reflection and angle-resolved scattering spectral measurements.

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PA003

Surface Enhanced Raman Scattering Activity of 0 and 1 Dimensional Silver Nanostructures

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[keywords] Surface Enhancement, Raman Spectroscopy, Silver Nanostructures

The discovery of the Surface Enhanced Raman Scattering (SERS) effect is very important because Raman scattering cross section is very small and difficult to observe the signal. SERS is a powerful technique for analyzing the electromagnetic field enhancement and the vibrational properties [1]. It is possible to extract significant amount of molecular specific data from a small amount of sample with high surface selectivity is the factor that makes SERS valuable. The reason of the enhancement is the difference between the incident electromagnetic field and local field on the metal surface due to surface plasmons resulting from excitation of conduction electrons [2]. The structure of the substrate is critical to obtain strong SERS. In addition to the several adsorbed molecules on metal surfaces, liquid-solid samples such as colloidal suspensions of silver nanostructures are in the field of research interest in the quest for increasing the enhancement factor [3]. In this study, we have investigated SERS effect by adsorbing Crystal Violet (CV) and Brilliant Cresyl Blue (BCB) on irregular structures of Ag nanoparticles and Ag nanowires deposited on glass in comparison to reference samples.

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PA004

Microstructure and Corrosion Behaviour Of AISI 4140 Steel Modified By Pulse Plasma Treatment

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Keywords: Pulse-plasma, Corrosion, Hardness, Molybdenum

The Pulse plasma treatment of surfaces is a process used to improve surface properties and corrosion resistance of the industrial tools. In this work, the influence of pulse plasma parameters to improve the performance of the AISI 4140 steel was presented. In this study, four different distances and three pulse numbers were used as the pulse plasma parameters. The molybdenum consumable electrode was used during the experiments. The treated samples were characterized by using optical micrograph, scanning electron microscopy (SEM), X-ray diffractometry (XRD) and micro-hardness tests. The micro-hardness values of modified surfaces are about four times higher than that of un-treated surfaces. Corrosion tests were performed to show the resistance of surfaces improved by using pulse plasma treatment. The mechanic and corrosion properties of samples were improved after pulse plasma treatment.

PA005

Magnetic properties of thin film and superlattices

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Keywords: Monte Carlo simulations, High temperatures series expansions; Thin film; Superlattice; Critical temperature; Magnetic coercive field.

The Monte Carlo simulations and high temperatures series expansions are used to investigated the magnetic properties of ferromagnetic thin film and superlattices through Ising model. The reduced critical temperature of the ferromagnetic thin film and superlattices is studied as function of the thickness of each layers. The exchange interactions in each layer and within the interface and the crystal field in the unit cell have been studied. The coercive field and magnetization remnant are obtained for different values of exchange interaction, with different values of temperature and crystal field for a fixed value physical parameters.

PA006

Electrical properties of p-n diodes based on undoped and Iodine doped ZnO nanorods prepared by hydrothermal method

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[keywords] ZnO nanorods, hydrothermal method, Current–voltage characteristics, impedance spectroscopy.

Iodine-doped Zinc oxide nanorods (ZnO:I) at different percentage (5-20%) were deposited on p-Si and glass substrates using an a hydrothermal method. The effect of Iodine element content on the morphological, structural, optical and electrical properties of ZnO:I films was investigated by scanning electron microscopy, X-ray diffraction and UV-Visible spectroscopy. The doping with iodine resulted in a slight decrease in the optical band gap energy of the films. The junction properties of the diode were evaluated by measuring the current–voltage characteristics. The I-V characteristics showed rectification behavior with a rectification ratio dependent on the applied voltage and the Iodine doping rate. ZnO/p-Si heterojunction diodes exhibited non ideal behavior with an ideality factor higher than unity. The barrier height for undoped and Iodine-doped ZnO/p-Si diodes was in the range 0.64-0.76 eV. By means of the Impedance spectroscopy analysis, we investigated the frequency relaxation phenomenon and the equivalent circuit of such a structure. Finally, the effect of the iodine doping rate on the spectral response was studied.

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PA007

Pulse electrodeposition of nickel-titanium nitride composite coatings

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[keywords] Pulse Electrodeposition, Nickel, Titanium Nitride, Morphology, Wear.

A nickel plating bath containing TiN particles was used to obtain hard and wear-resistant particle reinforced Ni-TiN MMCs for anti-wear applications. Copper substrates were used for pulse electro co-deposition of Ni and titanium nitride reinforcements with the particle size of <10 µm. The influence of current density on morphology, microhardness and wear resistance of composite coatings has been studied. The nickel films were characterized by scanning electron microscopy (SEM) and X-ray diffraction (XRD). The effects of the current density on the distribution of TiN particles in the nickel matrix and the tribological properties of composite coatings were also investigated. The tribological behaviors of the electrodeposited TiN composite coatings sliding against M50 steel ball (Ø 10 mm) were examined on a CSM Instrument. All friction and wear tests were performed without lubrication at room temperature and in the ambient air (relative humidity 55–65 %).

PA008

Kinetics of tartrazine photodegradation by Cu modified silicon nanowires

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[Keywords]: Silicon nanowires (SiNWs), Copper nanoparticles, photocatalysis, UV-VIS spectroscopy, DRX

The organic dyes contaminants present in industrial waste water are of major concern with respect to the health of the general public. Tartrazine is one of organic pollutants which is an azo dye and its degradation was very few studied. Up to now, their degradation was investigated mainly in the presence of H_2O_2 in an aqueous solution [1-2]. The application of semiconductors in heterogeneous photocatalysis based on the advanced oxidation process, to eliminate various pollutants in aqueous systems as well as in the air has gained significant attention in the last decade. Indeed, recently it was well shown that silicon nanowires are efficient for the degradation of the Rhodamine B. In this work we investigated the photodegradation of tartrazine by silicon nanowires (SiNWs) without presence of H_2O_2. SiNWs were elaborated with a simple chemical method termed metal-assisted electroless etching. SiNWs modified with copper was also experimented as catalysts for the degradation of tartrazine. Also, the effect of copper concentration was studied.
The photodegradation of tartrazine was monitored by UV-VIS spectroscopy and the diffraction spectra were obtained by means of a diffractometer. The results show that the photodegradation of tartrazine depend strongly on studied parameters and follows the pseudo-first-order reaction.

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PA009

Characterization of CdS Thin Films Grown by Chemical Bath Deposition Using Two Different Cadmium Salts

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Keywords: CdS thin films; Cadmium salts; Transmittance; PL; AFM; DRX

Cadmium sulfide (CdS) is a very important technological semiconductor material for use in a variety of devices such as photodetectors, piezoelectric transducers, solar cells, etc. Since it has been used as a window material in high efficiency thin film solar cells based on CdTe and $Cu(In,Ga)Se_2$. Although other techniques have been used in the deposition of CdS, Chemical bath deposition is a well-established method for enhancing the performance of cadmium sulfide window used in solar cell applications. Recent interest in CBD arises from their potential use in CdS nanotubes, in CdS nanowires and in optical materials. Deposition of CdS is based on the condensation of Cd^{+2} ions and S^{-2} on the substrate. Sulfide ions are released by the hydrolysis of thiourea, but Cd^{+2} ions form cadmium complex $(Cd(NH_3)_4^{+2}$ by adding a complexing agent to the Cd salt. These complexes, upon dissolution, results in the release of Cd^{+2} ions, then a heterojunction nucleation and growth take place by ionic exchange reaction with S^{-2} ions. For CdS chemical deposition, different cadmium sources have been used, such as cadmium sulfate, cadmium acetate, cadmium chloride and cadmium nitrate. Several researchers studied the influence of Cd salts on the properties of CdS thin films in order to obtain the desired characteristics which are essential for the production of high efficiency solar cells. In this work we report a comparative study of the effect of cadmium sources on chemical bath deposited thin films cadmium sulfide. Two different cadmium sources; cadmium sulfate ($CdSO_4$) and cadmium nitrate $Cd(NO_3)_2 4H_2O$ have been used.

The optical transmittance is made using Shimadzu 1650 PC UV-visible spectrophotometer in the wavelength range 300–1100 nm. Layers thickness (d) is measured by fitting the transmittance. The photoluminescence measurements are carried out using Perkin-Elmer LS 50B luminescence spectrometer. The photolumenescence (PL) spectra are recorded with the excitation wavelength of 457 nm. Surface morphologies are performed by atomic force microscopy (AFM) (Pacific Nanotechnology). The latter technique offers digital images which allow quantitative measurements of surface features, such as root mean square (RMS). The crystalline structure is analysed using a BRUKER D8 Advance X-ray diffractometer with $Cu\,K_\alpha$ line (wavelength: 1.54Å).

PA010

Effect of Gum Arabic on Hydrogen Evolution of Ni/Mo Electrodes Prepared by Electrodeposition Route

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[keywords] Co-deposition, Microhardness, Morphology, Corrosion resistance, inhibition efficiency.

The electrodeposited composite coatings know an increase development thanks to their particular properties obtained by incorporation of solid particles [1]**.** In the present work, we describe the electrodeposition of pure nickel and the co-deposition of Ni-Mo with different electroplating current densities. A traditional characterization tests such as adherence, corrosion behavior in 0.1M HCl, optical and scanning electronic microscopy, X-rays and Vickers microhardness show that the prepared coatings have a good adherence and hardness, and resist to corrosion. These coatings have a porous and cracked morphology at high values of plating current density [2]. Electrochemical impedance spectroscopy and potentiodynamic polarization tests show that the presence of gum arabic as an organic inhibitor in aggressive media improves the corrosion résistance and has an important values of inhibition efficiency, which reach to 73.66 %.

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PA011

Determination of the Refractive Index of Dielectric Films from the Transmittance Spectrum by Using Morse Wavelet

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[keywords] Refractive Index, Dielectric, Morse Wavelet, Transmittance.

The Continuous Wavelet Transform with the Morse wavelet was developed as a tool for the determination of the refractive index of a dielectric film. A theoretically generated transmittance spectrum in between 300-1200 nm wavelength interval was analyzed by presented method and the refractive index dispersion was obtained. The obtained refractive index was compared with the fringe counting [1] and envelope [2] methods and the input values. A noisy transmittance signal was calculated and analyzed by the presented and mentioned methods. The advantage and disadvantage of the method was also discussed.

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PA012

An Improved Method For Simultaneous Determination Of Refractive Index And Thickness Of Dielectric Films: A Simulation Study

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[keywords] Transmittance, Thin film, Thickness, Refractive index.

In this work an improved method [1] was presented for simultaneous determination of refractive index and geometrical thickness of dielectric films. In this method local maxima of transmittance spectrums measured at two different incidence angles of the light beam are used [2]. The method is based on the minimizing procedure with reasonable Cauchy parameters. It was tested on theoretically generated transmittance spectrums of dielectric film and the details of the minimization procedure were discussed.

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PA013

Aluminum doped amorphous silicon carbide by co-sputtering DC magnetron

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[Keywords]: amorphous silicon carbide, Al-doping, FTIR.

In this work, we studied the optical, structural and electrical properties of thin films of amorphous hydrogenated silicon carbide doped with aluminum, our samples were prepared by DC magnetron sputtering technique using a target 6H-SiC with a high purity. Doping was carried out by co-sprayed aluminum grains placed on the target during deposition. The rate of doping was varied by changing the number of grains. The samples were characterized by UV-vis optical transmission, FTIR spectroscopy and electrical measurements I-V-T. The optical parameters, deduced from transmission spectra [1], indicate a variation in the optical width band gap in the range of 1.7 - 2.2 eV by doping. Also, the rate of deposition was decreased with increasing the number of metal grains on the target. FTIR spectrum show the various modes of vibration of Si-C bonds, Si-H and C-H. Electrical measurements showed that the doping increases the electrical conductivity but also increases the activation energy which required an annealing to the samples.

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PA014

Development of Three-Dimensional Nanomorphologies in Carbon Thin Films

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[keywords] Nanomorphology, nanostructures, carbon thin films, CVD processes.

In this project, we have studied the growth, morphology and surface characterization of nanostructured carbon thin films obtained by high-density plasma chemical vapor deposition. Nanostructured thin films is composed of thin layers of nanostructured objects such as nanoparticles, nanorods, nanotubes, nanowires, and nanoporous network. The study of those nanostructured thin films are essential for exploring their properties and creating advanced applications [1-2]. Growing carbon thin films by high-density plasma chemical vapor deposition, we obtained three-dimensional nanostructured formation, such as nanoislands, nanoflowers and nanobridges. Thus, we could developed carbon thin films with different nanomorphologies, using pure methane plasma processes at room temperature. The substrates used to deposit the films were three-inch diameter silicon wafers, 380 µm thick and with orientation (100). To modify the surface energy of the silicon wafers and promote the nanostructure formation, before the carbon thin film growth, the samples were submitted to plasma etching step (RIE system, SF_6 plasma, 50 mTorr, 100 W, 2 min.) or a wet chemical etching step (one part of fluoridric acid and nine parts of nitric acid or TMAH (2.5 %wt @ 80ºC). The parameters of the DLC films depositions were: 15 mTorr, 250 W (coil power, RF, 13.56 MHz, remote plasma), 40-sccm methane and the final time deposition were varied (2, 3 and 4 hours). The samples were analyzed by AFM, SEM and FTIR. The kind of three-dimensional nanostructure formed in the carbon thin films depends strongly on the characteristics and the surface energy of the substrates. To each kind of etching, we have different quantities of sp^3 hybridizations, forming thin films with amorphous carbon matrix and island formed by carbon nanotubes and others kinds of nanostructures in this amorphous matrix. These results are unique and these three-dimensional nanostructures can be used for many applications.

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PA015

Thermal Effect on I-V Properties for GaAs MESFET transistors

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Key words: Thermal Analysis, temperature dependence, thermal effects.

The gallium arsenide field-effect transistor GaAs MESFET is an instrument used in electronic components . The structure of this device is composed from several thin layers. The active region in this structure is the channel N GaAs.The channel conductivity can be controlled by Schottky barrier gate and can be presented by the I-V properties . The increase of internal temperature in GaAs MESFET affects the performances I-V and operating limits of this component. To show the thermal effect on the characteristics I-V , we present in this study the influence of temperature (77 °K -500°K) in two analytical models for the both devices GaAs MESFET with low [1] and high pinchoff voltage [2] . The study is based on certain physical parameters depending on the temperature. The results obtained were compared with those of literature [3] .

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PA016

Influence of Deposition Parameters on ZnO:Ga Thin Films

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[keywords] TCO, ZnO, thin film, magnetron sputtering.

The preference of zinc oxide (ZnO) based materials as transparent conducting oxides (TCOs) improved for a variety of applications such as flat panel displays, solar cells, and gas sensors in recent years [1,. Various deposition techniques can be employed to achieve high quality films, among these magnetron sputtering is one of them. The characteristics of this method such as low cost, high deposition rate, good adhesion on substrate, good controllability, and long-term stability make it the most preferable one for industrial applications [2, 3]. In order to achieve a high quality film using sputtering, deposition parameters have to be optimized in detail [4]. Process power, pressure, gas composition, heating, target–substrate distance etc. are some of the critical deposition parameters. In this work, influence of both process pressure and power on ZnO:Ga thin films were investigated. 5 wt.% Ga_2O_3 doped zinc oxide (ZnO:Ga, 99.99% purity, 100 mm diameter , Kurt J. Lesker) thin films were deposited on glass substrates by using r.f. magnetron sputtering technique, at room temperature. Firstly, the process power was optimized in the range of 150 W to 230 W, at 45 mm target-to-substrate distance. In order to investigate the influence of process pressure, the deposition power was maintained at 165 W and pressure was changed from 0.2 Pa to 0.6 Pa. Obtained results were analyzed by using various characterization techniques such as: GIXRD, AFM, SEM, HRTEM, PL, LPA, XPS, four point probe and optical transmittance measurement techniques. Moreover, achieved data were compared with aluminum doped zinc oxide (ZnO:Al) thin films [5].

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PA017

Influence of some reactive elements addition on the microstructural, mechanical and tribological properties of niobium carbide coatings

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[keywords] Niobium carbide coatings, Thermo-reactive deposition, Reactive elements, Hardness, Phase analysis.

Niobium carbide coatings on AISI 4140 steel with addition of different reactive elements (Cr, Mo, V and Ti) were prepared by thermo-reactive diffusion/deposition (TRD) technique. The microstructures, elemental distributions and phase analysis of the coatings were characterized by scanning electron microscopy (SEM), energy dispersive X-ray spectrometry (EDS) and X-ray diffraction (XRD) analysis. The average micro-hardness values of the coatings were ranging from 2015 to 2396 $HK_{0.005}$. Rockwell C adhesion test showed a ductile behavior for NbCrC coatings with small cracks compared with others. The wear properties of the coatings are studied by means of ball-on-disc experiments at room temperature under 2.5, 5 and 10 N applied loads at 0.1 m/s sliding speed using alumina balls as counterparts. Characterization of the wear tracks was performed by SEM, EDS analysis and 3D optical profile-meter.

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PA018

Effect of Bilayer Period on the Properties of Mo_2N/CrN Multilayer Coatings Produced by R.F Magnetron Discharge

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Keywords: Mo_2N and CrN; Multilayer; Residual stress; Nanoindentation.

We have investigated the effect of the number of bi-layer period of Mo_2N/CrN multilayer with a constant thickness deposited on Si substrate produced by reactive magnetron sputtering. The total thickness of multilayer was 1 µm. The residual stress of the coatings was determined by the measurement of the substrate curvature. The microstructure of the multilayer was investigated from the X-ray diffraction and scanning electron microscopy (cross section images). Mo_2N presents a face centered cubic structure and CrN an orthorhombic one. The residual stresses resulting from the deposition of the different bi-layer number were measured and correlated to the structural properties of the coating as well as the nanoindentation analysis of the coating. The stresses are compressive and tensile for the individual Mo_2N and CrN layer respectively.

PA019

Optical, microstructural and photocatalytic properties of metals doped TiO_2 thin films

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[keywords] TiO_2 thin films, metals ions doped TiO_2, photocatalysis, microstructure.

In this study, structure, microstructure, optical properties and photocatalytic degradation of methylene blue (MB) have been investigated in an aqueous heterogeneous media containing pure and metal (Ag, Al, Cu) doped TiO_2 nanostructures thin films which were prepared by a simple sol–gel route. X-ray diffraction analysis confirmed that the prepared nanostructures crystallize within anatase-type structure and that the Ag and Al do not detected by XRD[1]. In cases of doping Cu, we noticed the presence of another phase such as CuO. Meanwhile, both the refractive index and optical band gap were affected by metals concentration. The surface morphology has been affected by all metals (Ag, Cu, Al) concentration dopants[2] but the photodegradation of methylene blue under UV-C radiation has been improved at low percentage of Al and Ag dopants. However, in the case of Cu we noticed that photodegradation decreases as the concentration of Cu increases. The photophysical mechanism of doped semiconductors is not always understood and the effect of metal ion dopants on the photocatalytic activity is a complex problem [3].

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PA020

Optoelectronic Properties of Nanostructured Carbon Thin Films by High Density Plasma Chemical Vapor Deposition

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[keywords] carbon nanotubes, thin films, optoelectronics properties, CVD process.

The electronic devices become better understood and they can be utilize as the fundamental building blocks to achieve additional funtcionality. An example of an emerging area of research in this direction is that of optoelectronics with carbon nanotubes. The interest in carbon nanotube optoelectronics arises because the nanotubes have several properties that make them excellent optoelectronic materials. For example, an important characteristic of optoelectronic materials is the presence of a direct bandgap, which allows electronic transitions between the valence and conduction bands to proceed without the intervention of phonons [1]. In this work, we have studied the optoelectronics properties of carbon nanotubes films obtained at room temperature by High Density Plasmas Chemical Vapor Deposition (HDPCVD). We used pure methane plasmas and different kinds of substrate surface preparation (diamond powder as a seed and topography modification by plasma etching) in order for obtain metallic or semiconductor multi-walled carbon nanotubes. The parameters of the depositions processes were: 15 mTorr, 250 W (coil power, RF, 13.56 MHz, remote plasma), 40-sccm methane and the final time deposition was 3 hours. The structural characteristics of the carbon nanotubes films were analyzed by AFM and SEM. The electrical features of the carbon nanotubes films were analyzed by Raman Spectroscopy, and the electrical proprieties by I x V electrical measurements, and the optical proprieties by photo luminescence and UV-Vis-Nir Spectroscopy. The photoelectric activity was obtained by induced photocurrent. The electrical resistivity, the electrical breakdown field and the semiconductor properties were determinated. Thus, the results showed that the carbon nanotubes films have unique optoelectronic properties and can be used to fabricate optoelectronic devices in nanometric scale. The carbon nanotubes films are optically homogeneous and showed excellent optical transmittance and good electrical conductivity. The photoluminescence effect and the high absorption of the carbon nanotubes films are attributed to inter-bands transitions. Carbon nanotubes films obtained by high density plasma chemical vapor deposition can be used as optical limiters and nonlinear optical devices, among other applications, such as photosensitive and light-emitting devices.

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PA021

Electrical and Photoelectrical Properties of (Poly(divinylbenzene)/ Multi-Walled Carbon Nanotube Nanocomposite)/n-Si Diodes

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[keywords] Carbon nanotube, Polymer, Electrical Properties, Photoelectrical Characteristics.

[Poly(divinylbenzene)/Multi-Walled Carbon Nanotube] [P(DVB)-MWCNT] / n-Si diodes were fabricated by using a surface polymerization method. The current-voltage (I-V) characteristics of the structure were investigated both in the dark and under various illumination conditions between 0.6 and 5.1 mW/cm^2. It was shown that the fabricated structures exhibited strong rectification behaviour. Electronic parameters of the diodes, such as ideality factor, barrier height and series resistance, were extracted from I-V and C-V measurements. In addition, the effect of illumination on the [P(DVB)-MWCNT] / n-Si structure showed that it was sensitive to light which makes it a promising candidate as a photodiode for optical applications.

PA022

Structural analysis of Ge nanoparticles embedded ZnO thin films by Laser Induced Breakdown Spectroscopy (LIBS)

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[keywords] LIBS, thin films.

Laser Induced Breakdown Spectroscopy (LIBS) has been employed for the large scale structral investigation of on Ge nanoparticles embedded ZnO multi layered thin films. The ultimate goal of this study was to determine the suitability of LIBS technique for ex-situ analysis of nanocomposite thin film structures by comparing the results of other techniques like XRD and SEM. ZnO thin films including nanostructured germanium nanoparticles (Ge-np) have attracted a considerable attention due to their potential applicability on new opto-electronic devices. Ge acquiring a comparatively larger Bohr radius, which is about 24 nm, makes it more attractive as far as the production easiness is concerned. Hence, it is important to thoroughly investigate the ZnO: Ge structure for making correlation between opto-electronic properties and the structure. LIBS can be used to analyze the particles in 150-200 nm depth by means of depth profiling and as a result, homogeneity of sample can be determined. Fast and reproducible low cost with minimum sample preparation analysis was developed to identify the Ge nanoparticles. For this purpose LIBS system was developed with maximum spectrum intensity versus sampling methods. Structure of ZnO: Ge samples was identified in less than 1 minute under ambient conditions. Results were compared with SEM and XRD results. Discrimination analysis (principle component analysis, PCA) have been performed to investigate different thin film structures. Eventually, signal to noise (SNR) and signal to background (SBR) ratios of elements have been evaluated to maintain the best detection conditions.

PA024

Structural and optical properties of transparent Y-doped anatase TiO_2 thin films grown by Nd-YAG laser annealing

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[keywords] Y-doped TiO_2, PLD, morphology, optical properties, waveguide.

Y–doped TiO_2 (Y:TiO_2) films were deposited at 450ºC onto glass substrates using pulsed laser deposition method. The used source was a Nd:YAG laser (λ = 355 nm, ν = 5 Hz, Φ = 2 J/cm^2 and τ = 8 ns pulse duration). Structural, morphology and optical properties of Y–doped TiO_2 thin films were studied. X-rays diffraction spectra showed that the undoped films consist of TiO_2 are polycrystalline of anatase structure with preferential orientation of (101) direction. AFM images, nanoparticles size and surface roughness mean square values showed that the surfaces of Y:TiO_2 films are smoother than that of undoped TiO_2 films. UV–Vis transmittance results reveal that Y-doped TiO_2 had significant optical absorption in the region of 300–350 nm and fully transparent in the visible. Both film thickness and refraction index dependence on the fraction of yttrium doping are derived from TE and TM modes excited in optical prism coupler. The optical band gaps and Urbach energies of the thin films were determined.

PA025

Effect of plasma oscillation on the ion deposition distribution in the process of an electron beam-heating metal substrate

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[keywords] plasma, ion distribution, electron beam.

This paper investigates the oscillation of ions in plasma generated by an electron beam (EB) interaction with material. Assuming the EB-generated plasma to be only a function of radial direction, the steady-state equations of continuity and momentum combined with Posson's equation were utilized to analyze the oscillation of ions along the radial direction in a vacuum chamber. The available experimental data are used to validate the model proposed by this study. The results show that the ion density can be enhanced by decreasing the ratio of the electron thermal energy to the initial ion energy and increasing the ratio of the initial ion density to the initial electron density. On the other hand, the amplitude of oscillation of ion density increases with the increasing ratio of the electron thermal energy to the initial ion energy and the decreasing ratio of the initial ion density to the initial electron density. The period of oscillation of ion density increases with the decreasing ratio of the initial ion density to the initial electron density.

PA026

Effect of Al doping on the structural and optical properties of SnO_2 thin films elaborated by sol-gel technique

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[keywords] Al-doped SnO2, Sol–Gel, XRD, AFM, SE,UV-Vis.

In this study, The influence of the aluminum addition on the structural, surface morphology and optical proprieties of the films of tin dioxide were investigated. Pure and aluminum-doped SnO_2 thin films were prepared by Sol Gel Dip Coating (SGDC) technique on glass and Si (100) substrates at room temperature and then annealed at 550°C in air. The obtained films was studied using grazing incidence X-ray diffraction (GIXRD), atomic force microscopy (AFM), UV–Vis spectrophotometry and spectroscopic ellipsometry (SE). The X-ray diffraction reveals that all films deposited on Si(100) substrate have tetragonal crystalline structure, but an amorphous structure is obtained for all the films prepared on glass substrate The AFM analysis show that The surface roughness, observed varies from 10.83 to 1.80 nm. The optical measurements show that the deposited Al:SnO_2 films are transparent (~ 86%) in the visible spectrum and a band gap energy decreasing from 3.68 eV to 3.49 eV with increasing of Al concentration. The obtained values of the refractive index of the films are ranging between 1.529 and 2.271.

PA027

Studies in Cu_2ZnSnS_4 based solar cells with various buffer layers

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keywords: CZTS, solar cell, buffer layer, SCAPS.

The performance of Cu_2ZnSnS_4 (CZTS)-based solar cells with various replacements for conventional CdS buffer layer, such as In2S3 deposited using PVD (physical vapor depostion) technique and ZnS deposited using CBD (chemical bath deposition) based buffer layers have been studied by SCAPS simulator in terms of layer thickness of the buffer to find out the optimum choice. For an optimum thickness of around 3µm of high-efficiency CZTS absorbers, the optimum thickness of buffer layers is found to be in the range of 40–60 nm. Improvements in efficiency were achieved for ZnS buffer layer and choosing the flat band option in SCAPS software. Based on the best possible optimization, an efficiency (η) of 11.8% and 12.5% were obtained for ZnS and In_2S_3 respectively.
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PA028

Comparative Study of ZnO Thin Films Deposited by Spray Pyrolysis and Sol-Gel Technique

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[keywords]: ZnO, spray pyrolysis, dip coating .

In the present work, ZnO sol was prepared using zinc acetate, 2-Methoxyethanol and monoethanolamine (MEA). Two different method were used for the deposition of ZnO thin films: spray pyrolysis and dip coating on glass substrate. The effect of useful method on the crystalline structure, morphology and optical properties of the ZnO thin films were investigated using X-ray diffraction (XRD), atomic force microscopy (AFM) and optical transmittance data. It has been found that the quality of our films are significantly affected by the applied method.

PA029

Numerical simulation of bias-illumination stress with equivalent oxide thickness effects of gate insulator on amorphous indium-tin-zinc-oxide thin film transistors (a-ITZO TFTs)

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[keywords] Numerical simulation, SILVACO, NBIS, a-ITZO, TFT, EOT, instability, stress.

Amorphous oxide semiconductors (AOS) have attracted considerable attention for various electronic device applications [1] such as solar cells, transparent electrodes, touch screen panels, optoelectronic devices, in flat panel displays, and often used as a channel in the thin-film transistors (TFTs) [2]. There is growing interest in AOS based on zinc oxide because considered as promising materials for the channel of thin film transistor (TFT) in the next generation display back planes because they can accomplish high mobility and large-area uniformity at low temperature process as well as the use of plastic substrate [3]. Most prominent of these materials is indium-gallium-zinc-oxide (IGZO) [4]. Amorphous-ITZO with a mobility higher than a-IGZO, and lower cost has become one of the most promising materials which have been developed for future advanced to the backplanes in ultra-high-definition and high-frame-rate displays for replacing the a-IGZO [5]. However, the threshold voltage of a-ITZO TFTs, like in other TFTs, can be severely degraded by different types of stress such as positive or negative bias, exposure to light, temperature or even mechanical strain [6]. There is still a great deal of confusion about the relation between defects and instability induced by stress [7]. The main purpose of this study is to elucidate the relation between the threshold voltage shift (instability) and the defects created by stress. In this purpose the negative bias illumination stress (NBIS)-induced instability of a-ITZO TFT was suggested along with the effect of equivalent oxide thickness (EOT) of gate insulator. The analysis was implemented through combining the experimentally extracted density of subgap states in reference [8] and numerical simulation of the device by the SILVACO TCAD software [9], that was used to carry out a detailed numerical analysis for investigate the relation between, the different type of defects created and the induced instability (the shift of the threshold voltage) in a-ITZO TFT depending on the effect of EOT of gate insulator. In this presentation we will discuss properties of a-ITZO TFTs with the effect of EOT of gate insulator before and after bias and illumination stress. We have already shown that negative bias of the gate enhances the shift in the characteristics (unstable) while positive bias reduces it [10]. This shift increases with increasing stress time. Therefore, during NBIS, it was observed that increase EOT causes increase in both the shift of threshold voltage (V_T) and the variation of subthreshold swing (SS) as well as the hump-like feature in a transfer curve [8]. Furthermore, EOT-dependences was studied the transfer characteristics (I_D-V_G), output characteristics (I_D-V_D), hysteresis characteristics, I_{ON} current, V_T, SS, μ_{FE} and energy band diagram of the semiconductor-insulator interface of a-ITZO TFTs before and after bias and illumination stress.

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PA030

Using Self Assembled Monolayer to Improve Device Performance of Organic Light Emitting Diodes

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There has been a great development in organic light-emitting diodes (OLEDs) during the last 20 years because of their advantages of self emission, low driving voltage, high efficiency, wide viewing angle and flexibility [1, 2]. In OLED devices, as shown in figure 1, metal electrode (ITO) is in direct contact with organic layer (TPD), but the work function of ITO and the energy level of organic materials have a large injection barrier. This barrier leads to poor charge injection and low efficiency[3]. In order to solve this problem, ITO substrates were modified with several techniques to increase energy level of ITO. Self assembled monolayers (SAMs) are one of the most promising technique to modify ITO surface due to its ease of processing and low cost.

In this study, ITO was modified with two different SAM materials. The OLED devices which have modified ITO with SAM materials were compared to OLED devices that has unmodified ITO and modified ITO with PEDOT:PSS via theirs electrical, optical and surface characterization.

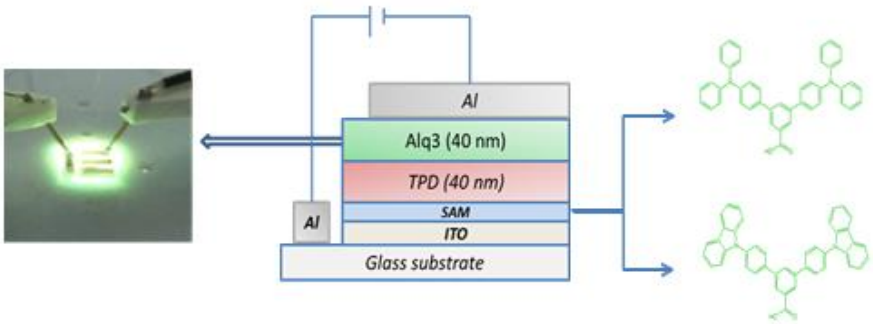

Figure 1. The General structure of an OLED with SAMs modified ITO

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PA031

The Effect of Fluorine Doping On Structural, Electrical and Optical Properties of SnO_2 Thin Films

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Keywords:
Fluorine Doped Tin dioxide (F: SnO_2), Dip-coating Technique, Solar Cell, Electrical Conductivity, Transmittance and Band gap.

Fluorine doped tin dioxide (F: SnO_2) thin films are a special kind of material that exhibit high electrical conductivity and at the same time a good transmittance in visible region making it suitable for solar cell applications [1]. To study the effect of doping on optical and conducting properties of F: SnO_2 thin films, a series of investigations were made. The thin films were deposited on a glass and p-type silicon substrates using a chemical solution of $SnCl_2.2H_2O$, NH_4F and Ethanol [2] by means of a sol-gel spin-coating technique, which offers better thickness control and uniformity. The rate of fluorine doping is adjusted by the amount of NH_4F added to the solution. The influences of doping concentration on the crystal growth, electrical and optical properties were investigated.

In second party, we fabricated F:SnO_2/Si heterojunctions and studied the influence of fluorine doping rate on their current-voltage characteristics. It is shown that doping with 5% fluorine, allows to obtain a thin layer of F:SnO_2 with electrical, optical and structural properties ideally suited for application as emitter in heterojunction solar cell.

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PA032

Fabrication of Cobalt Nanoparticles on Porous Silicon for Improved Photoluminescence

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[keywords] Porous silicon, cobalt nanoparticles, photoluminescence.

In this study, n-type PSi samples with macroporous were fabricated by the electrochemical etching method, and then Co nanoparticles were introduced into the PSi matrix using the electrodeposition technique. We have used scanning electron microscopy (SEM), X-ray diffraction (XRD), Raman and photoluminescence (PL) spectroscopy to study structural and optical properties of the PSi/Co nanostructures. SEM analysis has revealed that the cobalt nanoparticles formed both inside the PSi matrix and on the surface of PSi. The presence of the cobalt in the PSi matrix has been also confirmed by XRD and Raman spectroscopy. The Raman spectra of PSi/Co have shown that the Co atoms replaced by H atoms in weak Si-H bonds and formed more stable Si-Co bonds during the electrodeposition. The PL spectra of PSi/Co, prepared at different deposition times (5-60 min) and current densities (0.1-0.5 mA/cm^2), have indicated that a remarkable enhancement in the PL intensity of PSi/Co has been observed at 0.3 mA/cm^2 for 10 min with respect to PL intensity of PSi sample. However, for the longer deposition times, the PL intensity of PSi/Co has considerably decreased due to the autoextinction phenomenon [1]. The improved PL intensity may be attributed to the quantum confinement effect and recombination mechanisms, including radiative recombination through the surface states and through oxygen vacancies [2]. The results of our analyses suggest that the PSi/Co sample, with finely controlled atomic-scale structure is a good candidate for the potential applications in optoelectronic and sensor devices [3].

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PA033

In situ photoelectron spectroscopy of WO_3/LiPON interface for electrochromic devices

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[keywords] in situ XPS, UPS, WO_3, LiPON, interface, electrochromism, solid state

Electrochromic devices can modulate their optical transmittance and be used to modulate the solar transmittance of a window [1]. The mechanism is similar to that of a Li-ion battery. The insertion of cations (e.g. H^+ or Li^+) in the electrochromic material (e.g. WO_3 or Nb_2O_5) is comparable to a charged state and causes the coloration. To enhance the durability of these devices, the use of solid state electrolyte is envisaged. Lithium phosphorus oxynitride (LiPON) is a promising inorganic solid ion conductor. Its interfaces with $LiCoO_2$ and metallic Lithium were studied in the context of thin film batteries [2,3]. However, to the best of our knowledge, the study of the interface between WO_3 and LiPON has not been reported.

Interfaces between the electrochromic material and the electrolyte are of interest regarding the stability and the transfer resistance. In this paper, we will investigate the WO_3/LiPON interface. Deposition of LiPON, on top of WO_3, was performed step by step by reactive magnetron sputtering. After each deposition step, the layer obtained was analyzed in situ by UV and X-ray photoelectron spectroscopy (UPS and XPS). These measurements offer the possibility to measure energy band alignments and band bending at the interface. The study of the interfaces of electrochromic devices will provide insights on the electronic structure and a better understanding of the internal resistance and intermediate layers.

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PA034

Effect of Si doping on the transition temperature and electronic properties of VO_2 thin films

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[keywords] vanadium dioxide, thermochromic thin films, XPS, UPS, solar thermal.

Vanadium dioxide has long been at the forefront of research due to its fast and reversible semiconductor-to-metal transition (SMT) at a critical temperature (T_C) close to room temperature (~340K). It has raised considerable interest in a plethora of applications such as sensors [1], smart windows [2], steep-slope electronic switches [3], tunable capacitors [4], etc. In this work, the use of thermochromic VO_2 in switchable absorber coatings for overheating protection of solar thermal collectors has been considered.

Doping can alter the temperature at which the first order phase transition occurs. Most studies have been done on dopants decreasing the transition temperature, up to date the most successful proving to be W-doping, while only few considered dopants which could potentially increase the transition temperature. For solar applications, an increase in T_C is desired and for this purpose Si doping is attempted. Furthermore, as a functional solar device consists of a multilayered structure, determining the surface properties of the VO_2 thin films is necessary. Therefore, both Si doped and pure switching vanadium dioxide films have been deposited by means of reactive magnetron sputtering. The effect of Si doping on the transition will be assessed. The film surface is analyzed by in-situ X-ray and ultraviolet photoelectron spectroscopy. The differences between the electronic properties of doped and undoped films, as well as the change in intensity near the Fermi edge during the transition are discussed.

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PA035

Temperature Dependent Electrical Conductivity Behaviour of Sol-Gel Prepared Co:ZnO Thin Films

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[keywords] Co doped ZnO thin films, conductivity, sol-gel.

In this study, it was reported the results of structural, optical and electrical characterization of Co-doped ZnO thin films prepared on glass substrates by ultrasonic spray pyrolysis (USP) technique. It was observed that hexagonal wurtzite structure of ZnO is dominant up to the critical value of Co doping, and after the value, the cubic structural phase of the cobalt oxide appears in the X-ray diffraction patterns. It can be concluded from PL measurements that the energy band-edge of Co:ZnO films shifts to the lower energies. Optical transmittance at room temperature of the films was used to determination of the film thickness. In addition, Co substitution in ZnO lattice has been proved by the optical transmittance measurement which is observed as the loss of transmission appearing in specific region due to Co^{2+} characteristic transitions. Temperature dependent dark conductivity of the films was measured using the gap-cell geometry. Dark conductivity showed that the activated behavior in the high temperature range and activation energy o the films increased up to the critical value as X-ray analysis. However, it was observed that dark conductivity didn't depend on the temperature for the lower temperature region.

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PA036

Tribological Properties at Room and High Temperature Conditions of TiVZrN Graded Composite Coatings Deposited with CFUBMS

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Key Words: AISI H13, TiVZrN, CFUBMS, friction, high temperature

Multicompenent coatings used as protective against high temperatures, wear and aggresive media conditions of different compenents such as cutting and extrusion tools, casting rollers, parts of aircraft engines, gas-driven turbines. Therefore, in this study, TiVZrN graded composite coatings were deposited using closed field unbalanced magnetron sputtering (CFUBMS) to improve tribological properties at the room and high temperature conditions of AISI H13 steel substrate. Structural and mechanical properties of TiVZrN graded composite coatings were anaysed with XRD, SEM and microhardness-tester. A pin-on-disc tribometer was used to determine friction and wear properties of coatings. It was observed that structural and mechanical properties of TiVZrN graded composite coatings deposited with different coatings parameters have a significant effect on tribological properties at the room and high temperature atmospheres.

PA037

Plasmonic Effect on the Performance of Si-Based ZnSe Heterojunction

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[keywords] thin film, , metal nanoparticle, plasmonics.

In this work, the effects of the Ag nanoparticles on the device characteristics of Si based ZnSe thin film heterostructure were reported. Plasmonic enhancement interfaces decorated by conductive materials with a thickness of a few nanometer are used in a conventional bulk or thin film semiconductors in an application of the enhanced light absorption into the active region of semiconductor. Therefore, Ag is preferred as metal nanoparticles due to increased optical path length caused by the high scattering cross-section of particles and absorption of incoming light. Ag nanoparticles were used to improve the photovoltaic cell efficiency in the n-ZnSe/p-Si heterojunction diode by the help of plasmonic effect at the interface between ZnSe thin film and Si wafer layers. This heterojunction was fabricated by depositing 300 nm thick n-type ZnSe thin film layer on the p-type Si wafer substrate by using e-beam deposition technique. The commercial p-type Si wafers were used as a p-type layer to construct this p-n junction. They are about 600 μm thick, one-sided polished, in mono-crystalline phase with (111) orientation and their resistivity values are around 1-3 (Ω.cm). To fabricate the Ag plasmonic layer at the interface of the heterojunction, 10 nm thick Ag film was thermally deposited on the p-Si wafer. Then, Ag nanoparticles were formed by dewetting method at 200°C for one hour on a hot plate which was found an optimum temperature for the formation of the nanoparticles under nitrogen gas flow. The formation of these particles and particle size distribution on p-Si surface was checked by SEM measurements. In addition, ZnSe thin films were also deposited on the commercial soda lime glass substrate in order to determine the film characteristics of this layer. According to EDS analysis, the deposited ZnSe film was found to be nearly stoichiometric. From XRD measurements, this film sample was found to be in polycrystalline structure and the dominant peak in the diffraction spectrum was determined as in the zinc-blende structure at (111) preferred orientation direction with a good agreement in literature. The transmittance values of the film was analyzed by UV/Vis spectroscopy and the maximum transmissivity was observed as about 80% in the spectral range of 600-1100 nm. Band-to-band transition was obtained from Tauc plot and the fundamental optical band gap energy of the film was found about 2.38 eV. Moreover, the electrical analysis of the sample were done by dark conductivity and Hall Effect measurements. A comparison of the device characteristics of plasmonic Ag nanoparticles decorated on flat Si, n-ZnSe/Ag/p-Si, with reference bare Si, n-ZnSe/p-Si, was made by dark and illuminated current-voltage measurements.

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PA038

Device Characterization of Cu-Ag-Ga-Te Thin Films for Photovoltaic Applications

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[keywords] thin film, heterojunction.

In this work, p-type Cu-Ag-Ga-Te (CAGT) polycrystalline thin films deposited on n-type monocrystalline Si wafer substrate have been analyzed for photovoltaic applications. This quaternary compound is an electronic chemical analogue of II–VI compounds and a prototype member of the family of I-III-VI_2 chalcopyrite semiconductors with direct band gaps of 1.24 eV ($CuGaTe_2$) and 1.80 eV ($AgGaTe_2$). Moreover, it crystallizes into the $D_{2d}^{12} - I42d$ space group, and it shows direct band gap behavior and high absorption coefficient similar to the well-known Cu-In-Ga-Se (CIGS) structure. In order to investigate the thin film properties and device characteristics of the CAGT, they were deposited on soda lime glass and polished Si wafer substrates with the evaporation of pure elemental sources by using sequential stacked layer evaporation technique where the substrate was kept at about 200°C. The structural, optical and electrical characterizations of the films have been carried out on the film samples deposited on glass substrates. Then, for the analysis of the device parameters, Ag back contact and In dot front contacts were evaporated to complete In/p-CGIT/n-Si/Ag heterostructure. Detailed electrical characterization of this hetero-junction has been performed by means of current-voltage (I-V) and capacitance-voltage (C-V) measurements to investigate the device characteristics and to determine dominant conduction mechanism in this sandwich structure. The parasitic resistances for forward and reverse bias voltages, the ideality factor and the barrier height values of the heterojunction diode have been determined by performing I–V plots. In addition, built-in potential and interface states density of the deposited hetero-structure have been calculated and discussed by the help of frequency dependent C-V analyses. The photoresponse measurements of the CAGT/Si heterojunction have been carried out at room temperature under the monochromatic light having a wavelength in the range of 400 and 1300 nm in order to see the effects and contributions of the film layers on this device structure. Besides, at room temperature, the photovoltaic characteristic of the deposited heterojunction has been investigated under AM1 solar simulated illumination.

PA039

Dielectric Relaxation Mechanisms in CuO/Ball Type Phthalocyanine Composite Thin Films

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[keywords] Metal Oxide/Organic Composite Thin Films, Phthalocyanines, Dielectric parameters, Ac conductivity.

Metal oxide-organic composite materials have an increasing attention since they constitute a promising material family for optical devices, sensor coatings, and etc [1,2]. From this point of view, dielectric and impedance properties of CuO/ball type phthalocyanine composite thin films have been studied by impedance spectroscopy measurements within the frequency interval of 5Hz-13MHz. The frequency and temperature dependences of the real and imaginary parts of dielectric functions (□□′ and □□″) have been analyzed for the temperature range varies from 25ºC to 140ºC. It has been determined that while □□′ and □□″ exhibit a strong frequency dependence for the low frequency region, they also behave as frequency independent at high frequencies. The dielectric relaxation type and alternative current (ac) conductivity mechanisms of the composite thin films have also been investigated. The complex plane representation of the impedance (i.e. Nyquist curves) and the variation of phase angle with frequency (i.e. Bode curves) have been plotted and the equivalent circuit of the thin films have been determined.

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PA040

Optical and structural characterization of Cu_xZn_{1-x} thin films deposited by thermal evaporation

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[keywords] PVD, thermal annealing, XRD, Raman, Zn, Cu

Zinc oxide is a wide bandgap n-type semiconductor and has attracted attention as a transparent conductor material in solar cells, as gas sensors and more recently as thin film transistors. In this study, Zn thin films have been grown on glass slides by thermal physical vapor deposition. In order to get a coated glass substrate, Cu targets were also evaporated with Zn powder simultaneously in vacuum chamber. One of these films were oxidized in air atmosphere by thermal annealing and optical characteristics of ZnO were scrutinized with the help of XRD and Raman spectroscopy. XRD analysis revealed that, while the peaks at 34.52 and 37.79 are originated from (0 0 2), (1 0 1) planes of ZnO [1], the peaks at 36.52 and 39.12 indicate (0 0 2), (1 0 0) planes of Zn structure [1]. It is presumed that structural characteristics of ZnO becomes visible due to annealing treatment, since Zn characteristics lose their effect in structure. Particle size was also determined by Debye-Scherrer method for non-treated (as deposited) samples [2]. Increase of Cu dopping results in an increase of crystallite size from ~30 to 40 nm. This points out the effective role of Cu in Zn deposition. It can be inferred from Raman spectra, due to the effect of Cu dopping, the Raman peaks begin to resolve and get sharpener.

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PA041

Studying the CdTe based extremely thin absorber layer solar cell

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Novel ETA solar cells based on different nanostructured TiO_2 layers with CdTe and ZnSnTe thin film layers were fabricated in the laboratory scale and characterized to obtain the device parameters.

Nanostructured TiO_2 layers were deposited onto TCO coated glass substrates succeeded by deposition of extremely thin CdTe film. As the final step a void filling p-type ZnSnTe layer was deposited on CdTe layer to avoid the probable shunt between the p-type material and TCO layer. Finally Glass/TCO/TiO_2/CdTe/ZnSnTe/Au ETA sandwich structure was fabricated and the best efficiency was obtained.

PA042

The vibration dynamics of the ordred bimetallic Pt(110)Cu(110)/Pt surface alloys

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[keywords] surface alloys, matching theory, Bimetallic structures

We investigate the dynamical properties of the ordered bimetallic alloys of Cu/Pt(110)-(2×1) surface at a Cu coverage near 0.5 ML. The Newton equation is used, in the harmonic approximation, to calculate the matrix dynamics of the bulk. Whose appropriate eigenvalues and eigenvectors are necessary in the construction of the matching theory, adapted method for the model system; which associated to Green function framework allow to determine the local vibrational densities of states (LVDOS) for the Pt and Cu atomic sites in the surface atomic layers. The numerical results are discussed and interpreted. In particular, the transfer of charge between the Pt and Cu atoms in the surface alloys modifies the surface boundary force constants, with resultant remarkable differences for the vibrational DOS on the Pt and Cu atomic sites at the Cu/Pt(110) surface, compared to the DOS at the pure Pt(110) surface. This may favor new Pt-catalyzed reactions at such surface alloys.

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PA043

The superconductivity in Mg-doped InN grown by Molecular Beam Epitaxy

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Keywords: InN, MBE, superconductivity, magnetoresistivity, activation energy.

The superconducting behavior of InN has been observed in many experiments where the origin of superconductivity is addressed to presence of In-In chains in ab-plane, specific carrier density range limited Mott transition critical carrier density and presence of In_2O_3 impurities [1-3]. Since most of the studies on InN films show superconducting property without explaining the superconducting mechanism, here, we work on the superconducting flux-flow mechanism in Mg-doped InN film grown by molecular beam epitaxy (MBE). The superconductivity phase transition temperature has been observed at T_c= 3.97 K as determined by magnetoresistance and Hall resistance measurements in Mg-doped InN. The Superconductivity phase transition can be explained in terms of existence of a uniform distribution of superconducting InN nano particles or nano-sized In dots forming microscopic Josephson Junctions in the heavily compensated insulating bulk InN matrix. The onset temperature values, $T_{c.on}$ values decrease with the increasing applied magnetic field. The variation of the onset temperatures are around 2 K within the magnetic field range of 0.0 to 1.0 T. The decreasing of critical temperatures under higher magnetic fields in type-II superconductors might be explained that an electrical resistivity and energy dissipation emerges when the pinning flux lines are moved with the increasing Lorentz force. Therefore, the critical temperatures shift to lower temperatures with increasing applied magnetic fields. The superconductivity can be completely disappeared when an enough high critical magnetic field is applied. The broadening of the superconducting transition from onset to offset temperature is related to the energy dissipation caused by vortex motion. This region can be named as the thermally activated flux flow (TAFF) where the resistivity coming from the vortex motion. To determine the thermally activation of fluxes to the pinning barriers, the activation energy, U is obtained from the slopes of the nearly straight line part of the curves at lower temperatures. It is observed that the sharp decreasing of activation energy even under a small magnetic field shows the destruction of weak link in the inter-granular coupling, the contraction of distance between pinning centres and decrement of the energy barriers in the film.

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PA044

Determination of longitudinal optical phonon energy of $GaAs_{1-x}Bi_x$ quantum wells (QWs) grown on various orientations by MBE

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Bi-composition dependence of longitudinal optical (LO) phonon energy of $GaAs_{1-x}Bi_x$ quantum well (QW) structures grown on (100) and (311)B orientations was determined by Raman spectroscopy technique. The samples of $GaAs_{1-x}Bi_x$ (x: 1%, 2% and 3%) were grown by Molecular Beam Epitaxy (MBE) with various Bi concentration. The energy of LO phonons of $GaAs_{1-x}Bi_x$ (QW) were directly obtained by GaBi (LO) modes of Raman spectra and determined as a function of Bi content. Two phonon modes can be identified as GaBi transverse optical (TO(Γ)) and LO(Γ) phonon modes which are observed at ~185 and 213 cm^{-1}, respectively. The Raman spectra shows that GaAs-like LO(Γ) phonon mode (244 cm^{-1}) shifts toward lower frequencies by increasing Bi-concentration which is induced by strain effect due to alloying. In comparison to Bi-free GaAs sample, Bi-containing sample exhibited a broad band in spectral range between 180-230 cm^{-1}. GaAs TO (Γ) is dominant phonon mode for the samples grown on (311)B GaAs substrates while GaAs LO is more dominant mode for (100).

Keywords: GaAsBi, MBE, Quantum well, Raman Spectroscopy.

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PA045

Study on the Performance of AlInP/n-InGaP/p-InGaP/AlGaInP Top Cell In Triple Junction Solar Cell

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[keywords] Top cell, AMPS-1D, efficiency, $In_{0.5}Ga_{0.5}P$, defects.

InGaP is the most promising material for the top cell in multijunction solar cells [1], with a bandgap about 1.87 eV. Defects induced by radiation and carriers movement effect are the important investigations to evaluate the performances of solar cells for space applications [2].

In this study, we report the performances of the top subcell AlInP /n-InGaP/p-InGaP/ AlGaInP structure of the $In_{0.5}Ga_{0.5}P/In_{0.5}Ga_{0.5}As$/Ge triple-junction solar cell using numerical simulation AMPS-1D device simulator. Photovoltaic parameters were determined using current density-voltage (*J-V*) curves. This simulation is based on two ways. Firstly, we haven't taken account the absorber's defects. The obtained efficiency is about 25.93%, with the open-circuit voltage V_{oc}=1.745 V and the short circuit-current J_{sc} =16.1 mA/cm^2. In the second case, the major carrier trap labeled in $In_{0.5}Ga_{0.5}P$ is HP1, which appears at 0.9±0.05 eV above the valence band, is considered. It is a recombining center, which affect significantly the performances of the top cell [3]. With 8,5.10^{14} cm^{-3} defect concentration, the obtained efficiency is 19.82%, with V_{oc} = 1.417 V and J_{sc} =16.03 mA/cm^2. A degradation of efficiency ~ 6.11% is obtained.

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PA046

Parameters Extraction of Solar Cell Based on p-Si/n-Zno:Al Structure Using Genetic Algorithm

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[Keywords] Parameters extraction, Solar cell, Genetic Algorithms, ZnO:Al

Electrical parameters extraction of solar cell is of crucial importance to quality control during the production or to provide indications on their operation once on site [1-3]. The estimated parameters are usually the photocurrent Iph, the saturation current Is, the ideality factor n, the series and shunt resistance (Rs and Rsh). Among the best way to extract the electrical parameters is the application of genetic algorithm [4-6]. In this work, we propose to develop a method based on the single diode model circuit, which able to extract the five electric parameters. In this context, an approach based on the genetic algorithms (GA) was developed in order to model and optimize the simulated data of the solar cell based on silicon as an absorber and ZnO:Al as a transparent conductive oxide. Using AMPS-1D simulator, the summarized photovoltaic parameters were obtained (the short-circuit current density: Jsc= 23.52 mA/cm², the open-circuit voltage: Voc=0.665V, the fill factor: FF=0.831) and the conversion efficiency: η=13.00%). A program developed on Matlab environment which is called the functions gaoptimset from the command line is tested and validated. After, we used the GAs to estimate the cell electrical parameters from the simulated J–V curve of p-Si/n-ZnO:Al solar cell. The photocurrent density Jph = 23.5. mA/cm², the saturation-current density Js = 9.3376x10-10 mA/cm², the ideality factor n = 1.0012, the series resistance Rs = 0.195 Ω, and the shunt resistance Rsh = 2.0 kΩ.

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PA047

Characterization of thin-film $Li_{0.5}La_{0.5}Ti_{1-x}Al_xO_3$ Electrolyte for all solid state Li-ion batteries

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[Keywords] Ionic conductivity, $Li_{0.5}La_{0.5}Ti_{1-x}Al_xO_3$, Solid electrolyte, Magnetron Sputtering

Renewable energy harvesting, conversion, storage, and distribution are of great interest due to demand created by portable electronics, transportation, and energy storage systems. As power requirements become more demanding, batteries are also expected to provide higher energy densities at lower dimensions. Although commonly used liquid electrolytes serve a high ionic conductivity at room temperature, they have begun to fail because of the safety concerns like; leakage and pollution [1]. Therefore, lithium ion conducting solid electrolytes have received substantial interest because of their significant advantages like absence of leakage, pollution, thermal stability, miniaturization capability. So, among the existing ceramic materials, the perovskite-type Li ion conducting $Li_{3x}La_{2/3-x}\square_{1/3-2x}TiO_3$ (LLTO) compound has attract much attention because of its high ionic conductivity, i.e., $\sigma = 10^{-3}$ $S.cm^{-1}$ at room temperature for x=0.11 [2,3]. Beside these, development of thin film technology enables us to produce solid electrolytes with higher gravimetric and volumetric energy densities; however, ionic conductivity of solid electrolytes must be improved for them to succeed in being applied commercially. Therefore, in this research, in order to fabricate solid electrolytes with high ionic conductivity, thin film electrolytes of $Li_{0.5}La_{0.5}Ti_{1-x}Al_xO_3$ were grown by RF magnetron sputtering in Ar atmosphere. In order to investigate effect of Al_2O_3 on ionic conductivity, compositions with various amounts of $Li_{0.5}La_{0.5}Ti_{1-x}Al_xO_3$ (x=0, 0.01, 0.05, 0.10, 0.15) targets were prepared by conventional solid state reactions for the thin film deposition process. It is observed that certain amount of Al_2O_3 (x) has some beneficial effects on ionic conductivity. Also for the grain growth, anneal treatment is conducted. Furthermore, structural and compositional properties were characterized by XRD, Raman spectroscopy, XPS, and SEM. Also, electrical measurements were done at room temperature from 0.1 Hz to 200 kHz by AC impedance spectroscopy forming ITO/LLTO/Al capacitor like structure.

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PA048

Spectral response of porous thin hydrogenated amorphous silicon carbide films (a-$Si_{0.7}C_{0.3}$:H)

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[Keywords] porous SiC; photoelectrochemical etching; amorphous SiC; spectral response;

In this work, we present the formation of Porous layers on hydrogenated Amorphous Silicon Carbide thin films (PASiC) by photoelectrochemical etching using HF/Na_2CO_3 solution under laser illumination at 534 nm wavelength. The amorphous films a-$Si_{0.72}C_{0.28}$:H were elaborated by d.c. magnetron sputtering using a hot pressed polycrystalline 6H-SiC target. The anodisation of the sample was done with formation parameters of current density of 3.5 mA/cm^2, and 50% HF (5%) / 50%Na_2CO_3 (0.5M) solution for different etching times from 12 to 60 sec. The etched surface was characterized by scanning electron microscopy, infrared spectroscopy, and photoluminescence. The results show that the morphology of etched a-SiC: H surface evolves with etching time. For an etching time of 12 sec the surface is porous with 80 nm to 150 nm of diameter, and more the time of anodisation increases the pores are more intense. Photoluminescence characterization of etched a-$Si_{0.72}C_{0.28}$:H samples for 12 sec shows a high and an intense blue PL. Finally, these results we encourage to elaborate devices structures based on this substrate as humidity sensors. A spectral response was studied at λ = 400 nm for Au/a-SiC/pSi Schottky photodiode.

PA049

Production of Au-Ag Thin Films and Investigation of Some XRD and XRF Parameters

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Keywords: Au, Ag, thin film, XRD, XRF, EDX, SEM and X-Rays.

In this study, Au-Ag thin films of various concentrations were produced by thermal evaporation method. The structural features, the electronic properties (X-ray emission probabilities), and the atomic percent concentrations of the produced these thin films have been investigated by EDX system, XRF technique and XRD system, respectively. Au-Ag thin films were found to have a cubic structure. It is not the same the characteristic X-rays emitted by an element in pure form with characteristic X-rays emitted by an element being in the structure of compound, alloy or thin film. The reasons for these differences were explained and the results were interpreted according to this situation.

PA050

Morphological Characterization of Zinc Oxide Nanomaterials and Their Applications in Dye Sensitized Solar Cells

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[keywords] ZnO, morphology, dye solar cells

ZnO is one of the nanomaterial used in dye sensitized solar cells [1]. Doped ZnO materials appear to be extremely sensitive to the conditions of their preparation. Many techniques have been developed to synthesize ZnO nanocrystals. The aqueous solution method is considered an effective approach for fabrication of transition metal doped ZnO nanomaterials [2-4].

In this study, a simple one-step solution route for synthesizing ZnO nanomaterials using microwave oven. ZnO nanoplate and ZnO nanoflower nanocrystallites have been obtained from hydrothermal reactions. Doped ZnOs were synthesized using microwave oven by hydrothermal method from zinc and cobalt precursors. The obtained products washed with water and were dried overnight at 80 ^{o}C in hot air oven and desicator. The resulted Al:ZnO nanomaterials were structurally characterized with various techniques. The Al concentration was varied from 0.5 to 1.5 mol %. The Al doped ZnO materials were analysed with Scanning Electron Microscopy (SEM) Techniques, X-ray diffraction Analysis (XRD), Energy Dispersive X-ray Analysis (EDX). The X-ray pattern clearly showed the presence of crystalline Al:ZnO particles. Al doped ZnO nanomaterials were tested in dye sensitized solar cells to evaluate their performances.

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PA051

Polyvinyl chloride-co-Activated carbon nanoparticles nanocomposite electrodialysis cation exchange membranes: Fabrication and characterization in desalination process

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[Keywords] Nanocomposite, Thin film, Ion exchange membrane, Activated carbon nanoparticles, Fabrication/Characterization, Desalination.

In this research, mixed matrix PVC based-co-activated carbon nanoparticles heterogeneous cation exchange membranes were prepared by solution casting technique. The effect of used additives, electrolyte's concentration and pH variations on membranes electrochemical properties were studied. Membrane water content was increased initially by the increase of activated carbons nanoparticles loading ratio up to 0.5 %wt in casting solution. The water content was declined again by more increase of nanoparticles concentration from 0.5 to 4 %. Membrane fixed ionic concentration, transport number, selectivity and membrane electrical conductivity all were enhanced by the increase of additive concentration. Utilizing activated carbon nanoparticles in the casting solution also led to increase in membrane electrical conductivity, ionic flux and permeability. Moreover, the membrane transport number and selectivity were improved initially by the increase of electrolyte concentration and then began to decrease at high electrolyte concentration. In addition, membrane showed higher transport number and selectivity at neutral pH compared to other pH values. Utilizing of activated carbon nanoparticles in membrane structure caused to more efficiency in heavy metal ions removal from water for the modified membranes. The obtained results are valuable for electro-membrane processes especially electrodialysis for water recovery and treatment.

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PA052

Influence of Al co-doping on the structural, optical, and electrical properties of Cu-doped ZnO thin films

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[keywords] Al-Cu co-doped ZnO (ACZO) thin films, sol-gel process, carrier transport mechanism

Al-Cu co-doped ZnO (ACZO) thin films with fixed Cu content at 1 wt% and different Al contents (1, 3, and 5 wt%) were successfully synthesized on glass substrates using a sol-gel process. The effects of Al doping on the structural, optical and electrical properties of the films were examined. The change in lattice parameters and average crystalline size were demonstrated by XRD measurements. The band gap values of the films were determined by mean of UV–VIS spectroscopy. A slightly change in the value of band gap was observed with varying Al content. The carrier transport mechanism of the films was investigated in terms of temperature dependent conductivity. The largest value of conductivity was obtained at 3 wt% Al content.

PA053

Growth of large area, single- and few-layer graphene on Ni-Cr by CVD method

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One of the most interesting materials in this century is graphene because it has novel useful electrical, chemical and mechanical properties. Finding new and cheap methods to synthesize graphene is very important, and Chemical Vapor Deposition (CVD) method is the most common method to grow highly oriented graphene. Nickel is widely used as a catalyst for the growth of graphene due to its close lattice match to graphene, one can expect similar or better controlled results using alloys of Nickel with other 3d transition metal elements which will not change its fcc crystal structure. In this study we report synthesis of graphene on Ni-Cr substrate by CVD. The graphene layers were grown on Ni-Cr in a CVD furnace at 1000°C using hydrogen gas as a reducing agent to clean to oxide layers on Ni-Cr and methane was used as a carbon source. Raman Analysis as shown in Figure 1 revealed that very high quality single and few-layer graphene with large area (about more than 50µum×50µm) was grown on special Ni-Cr substrate.

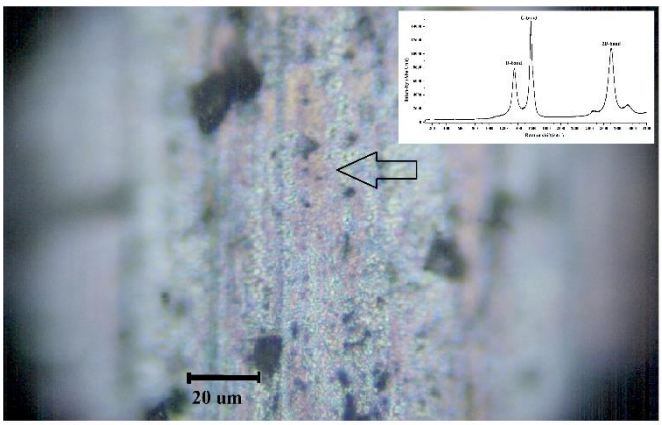

Figure 1. Optical microscope image of graphene on Ni-Cr. (Inset) Raman analysis reveals D-band and G-band at 1360cm-1 and 1580cm-1 and 2D-band at 2700 cm-1 with low FWHM less than 80cm-1 for all of peaks I2D/IG=0.13

AFM images shows that graphene layers have less than 2-3nm corresponding to 6-9 layers of graphene. We find that Ni-Cr is a very suitable substrate to growth high quality graphene layer with less number layer compared to graphene grown on pure nickel, and the size of it on surface can be controlled by optimizing the gas flow and pressure.

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PA054

Decolouration of Orange II solutions by the active layers of Cu-doped ZnO deposited on ceramics based on mullite and zircon

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[keywords] mullite, zircon, sol-gel, autoclave, zinc acetate, copper acetate, UV lamp, the degradation time.

Thin layers of zinc oxide and ZnO doped by copper acetate (0%, 4%, 6%) have been deposited on ceramic pellets consist of mullite and zircon [1]. On the other hand, different percentage of copper oxide and zinc oxide are added to the powder of the same ceramics. The thin layers in the first case are prepared by sol-gel [2]. In the second case were prepared by autoclave. The characterization of the layers obtained is made by the test of the photocatalytic degradation of organic dye Orange II [3-4]. For this characterization we used an aqueous solution of 12.5 mg / l, and a visible light provided by a UV lamp 4W. In real conditions, the layers deposited on the ceramic by the autoclave method show better performance than the sol-gel method.

We studied the effect of this doping on the structural activity, the morphology and the photocatalytic thin layer. The X-ray diffraction reveals that we see more of the essential phases of ceramics (Mullite, Zircon, Zirconia and cristobalite) there are new peaks with preferential orientation (100), (002) and (101) for the phase of the ZnO hexagonal wurtzite. The effect of doping with 6 wt% Cu showed a single peak of a very low intensity (200), this orientation was observed for the diffraction of CuO and Cu_2O phase is the corresponding [1- 5].The morphology of the outer layers is studied by AFM, it was found that increasing the concentration of Cu causes the decrease of the surface roughness. The roughness passes 229.7 nm, for the undoped ceramic 190.2 nm for the same ceramic ZnO doped by 6 wt% Cu. The photocatalytic activity is performed on the orange II (O-II) in the UV- visible by pellets, where the ceramic material has a majority. They are used as catalysts. A rate of degradation of OII reached 76.8% for a period of 6 hours. These good results are obtained from samples prepared by autoclave, based DD_3 clay with ZrO_2 and doped ZnO 6 wt% Cu.

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PA055

Nitrogen Doping of Graphene by Plasma Treatment

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[keywords] Graphene, Nitrogen Doping, Raman Spectroscopy

Introduction of foreign atoms into the graphene lattice can lead to a change in the carrier concentration and open the bandgap due to symmetry breaking. Recently, nitrogen doping has been an effective way to customise the properties of graphene and exploit its potential for various applications. In the literature, there have several reported methods for nitrogen-doping of graphene such as segregation growth, direct synthesis, arc discharge and thermal treatment [1]. In this work, we doped graphene with nitrogen by using plasma treatment method.

In this study, we grew large area graphene with methane and ethylene on copper foil at low pressure by CVD. After the growth, the graphene films were transferred to Si/SiO_2 wafer then samples were doped in the plasma chamber. The chamber pressure was reduced down to ~30mTorr in 5 min. After the placement of the transferred graphene into the chamber, the high purity N_2 (5 N) with a flow of 4.1 - 23.1 sccm was regulated by a bleeding valve to set the pressure in the range of 826 - 1060mTorr. Then nitrogen was introduced into the chamber to create plasma by applying a radio-frequency forward power of 7 Watt (low power), 10 Watt (medium power) and 30 Watt (high power). Lastly, the plasma doping duration was varied between 5 and 20 min.

We used Raman spectroscopy to characterize N-graphene. Since the intensity ratio of G' and G peaks ($I_{G'}/I_G$) is dependent on doping, the intensity ratio of D and D' peaks is to probe the nature of defects ($I_D/I_{D'}$) and intensity ratio of D and G peaks (I_D/I_G) give an information about the relationship between the crystallite size and nitrogen doping level owing to the defects [1, 2], these intensity ratios were calculated. Additionally, the shift of G peak position was also investigated after doping process. We also provide Raman mapping of N-graphene to show homogeneity of nitrogen doping in the graphitic lattice.

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PA056

Design and Device Application of Si-Based Cu-Ag-Ga-Te Thin Film Heterostructure

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[keywords] thin film, heterojunction.

In this work, p-type Cu-Ag-Ga-Te (CAGT) polycrystalline thin films deposited on n-type monocrystalline Si wafer substrate have been analyzed for photovoltaic applications. This quaternary compound is an electronic chemical analogue of II–VI compounds and a prototype member of the family of I-III-VI_2 chalcopyrite semiconductors with direct band gaps of 1.24 eV ($CuGaTe_2$) and 1.80 eV ($AgGaTe_2$). Moreover, it crystallizes into the $D_{2d}^{12} - I42d$ space group, and it shows direct band gap behavior and high absorption coefficient similar to the well-known Cu-In-Ga-Se (CIGS) structure. In order to investigate the thin film properties and device characteristics of the CAGT, they were deposited on soda lime glass and polished Si wafer substrates with the evaporation of pure elemental sources by using sequential stacked layer evaporation technique where the substrate was kept at about 200°C. The structural, optical and electrical characterizations of the films have been carried out on the film samples deposited on glass substrates. Then, for the analysis of the device parameters, Ag back contact and In dot front contacts were evaporated to complete In/p-CAGT/n-Si/Ag heterostructure. Detailed electrical characterization of this hetero-junction has been performed by means of current-voltage (I-V) and capacitance-voltage (C-V) measurements to investigate the device characteristics and to determine dominant conduction mechanism in this sandwich structure. The parasitic resistances for forward and reverse bias voltages, the ideality factor and the barrier height values of the heterojunction diode have been determined by performing I–V plots. In addition, built-in potential and interface states density of the deposited hetero-structure have been calculated and discussed by the help of frequency dependent C-V analyses. The photoresponse measurements of the CAGT/Si heterojunction have been carried out at room temperature under the monochromatic light having a wavelength in the range of 400 and 1300 nm in order to see the effects and contributions of the film layers on this device structure. Besides, at room temperature, the photovoltaic characteristic of the deposited heterojunction has been investigated under AM1 solar simulated illumination.

PA057

Fabrication and Characterization of Ag-TiO_2-NTs and Investigated Carrier Density in I^-/I_3^- Electrolyte by Electrochemical Impedance Spectroscopy

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[keywords] Ag-TiO_2-NTs, Electrodeposition, EIS analysis, Carrier density.

TiO_2 has been regarded as promising semiconductor material, due to its large surface area, high porosity, good electrical transport, low charge carrier recombination loses and excellent structural durability [1]. In this study, TiO_2-NTs electrode was successfully fabricated by two-step anodization technique. Then, the potentiostatic deposition was performed at -0.3V and various deposition times (240, 600 and 1800 s) in 0.75 mM $AgNO_3$ solution containing 10 mM KNO_3 supporting electrolyte. The morphology, composition and structure of Ag doped TiO_2-NTs were determined by field emission scanning electron microscopy (FE-SEM), energy dispersive X-ray spectroscopy (EDX) and X-ray diffraction (XRD). The results showed that as deposition time increases, Ag NPs size continued growing and based on the XRD results, after deposition of Ag, the crystallite size of anatase TiO_2 decreased from 22.43 nm to 14.62 nm and increased with increasing of deposition time (from 240 s to 600 s and 1800 s) from 14.62 nm to 18.38 nm and 17.33 nm, respectively. The electrochemical behaviors of Ag doped TiO_2-NTs in acetonitrile electrolyte contained I^-/I_3^- were examined by utilizing Electrochemical Impedance Spectroscopy (EIS). The Mott-Schottky analysis revealed that the charge transport in Ag doped TiO_2 electrode, (having the highest charge carrier density ($3.96.10^{19}cm^{-3}$)) obtained after 600 s of deposition time is realized faster.

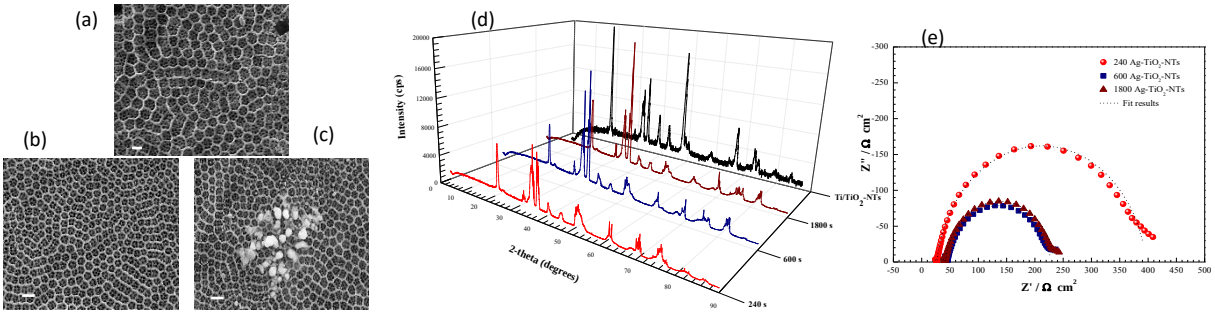

Figure 1. FE-SEM images and XRD patterns of Ag doped TiO_2-NTs electrodes obtained at constant potential of -0.3 V at different time ((a) 240, (b) 600, (c) 1800 s). Nyquist plots (e) recorded at -0.4V for Ag doped TiO_2-NTs electrodes in acetonitrile electrolyte contained I^-/I_3^- after 1h of electrode immersion.

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PA058

Preparation of Poly(3-Hexylthiophene) Sensitized Ag Doped TiO_2-NTs and Its Carrier Density Determined by Mott–Schottky Analysis

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[keywords] Ag doped TiO_2-NTs, 3HT, EIS analysis, Mott-Schottky analysis.

Poly(3-Hexylthiophene) (P3HT) has been widely used as an active material in fabrication polymer optoelectronic devices [1]. In this work, the synthesis of P3HT was successfully carried out by oxidative polymerization with $FeCl_3$. P3HT has been characterized using NMR, FT-IR, XRD and optical properties of P3HT are measured from Uv-Vis techniques. The result showed that the estimated optical band gap is 2.2 eV for P3HT. The deposition of Ag on TiO_2-NTs electrode fabricated by two-step anodization technique was performed with the galvanostatic technique. Then, the P3HT film was prepared on Ag-TiO_2-NTs by spin coating technique. The morphology, composition and structure of P3HT sensitized Ag doped TiO_2-NTs were determined by field emission scanning electron microscopy (FE-SEM) and X-ray diffraction (XRD).The electrochemical behaviors of P3HT sensitized Ag doped TiO_2-NTs in acetonitrile electrolyte contained I^- /I_3^- were examined by utilizing Electrochemical Impedance Spectroscopy (EIS) and Cyclic voltammetry (CV). The EIS results displayed that after the modification with P3HT, the value of charge transfer resistance at -0.4V decreases from 574 Ω cm^2 to 121 Ω cm^2, compared to pure TiO_2-NTs. This indicates that P3HT supplies better photogenerated electron-hole pairs separation and mobility. From the Mott–Schottky analysis, semiconductors of TiO_2-NTs and P3HT sensitized Ag doped TiO_2-NTs were found to be n-type conductivity and the carrier charge densities were determined to be $7.43.10^{21}$ cm^{-3} and $8.70.10^{21}$ cm^{-3}, respectively.

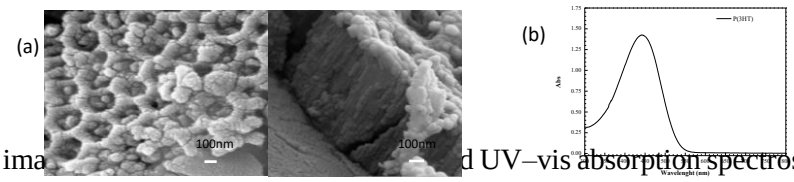

Figure 1. FE-SEM ima d UV–vis absorption spectroscopy of P(3HT) (b).

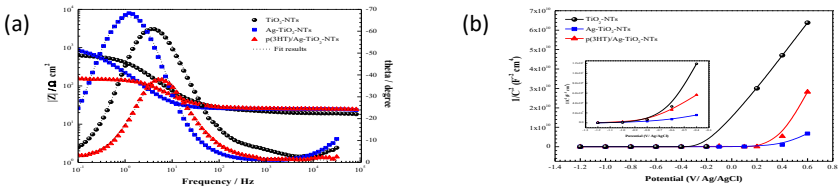

Figure 2. (a) Bode and phase angle plots recorded at -0.4V and (b) variations of ($1/C^2$) with applied potential (Mott-Schottky plot) for the electrodes in acetonitrile electrolyte contained I^-/I_3^- after 1h of electrode immersion.

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PA059

Fabrication, characterization and modelling of n-ZnO /p-Si solar cells

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[keywords] Heterojunction, zinc oxide, silicon solar cell, sol-gel technology, modellin

Zinc oxide (ZnO) thin films are of considerable interest due to their high performance as functional layers in solar cells, as well as in many other applications in solid-state electronics. Herein we report a study of a single heterojunction solar cell based on crystalline p-type silicon and n-type zinc oxide. The ZnO/Si heterojunction is fabricated by sol-gel deposition of ZnO on a p-Si wafer.
The starting material for preparation of zinc oxide is zinc acetate dehydrate ($Zn(CH_3COO)_2 \cdot 2H_2O$. Sols were prepared using isopropanol (C_3H_7OH) with addition of monoethanolamine (C_2H_7NO) as a solvent [1]. The films were deposited on pre-cleaned microscopy glass slides and silicon substrates by spin coating at 3800 rpm for the duration of 3-5 s. In order to remove organic residues, the films were heated up to 80 °C by an infrared radiation lamp. The samples were then annealed at 275 °C for 10 min. The process of coating was repeated to obtain the film thickness in the range of 150-300 nm. The final annealing was performed at 500°C for one hour.

To characterize the obtained ZnO films, a comprehensive study of their surface morphology, structural, optical and electrical properties was conducted. Optical studies demonstrated high transmittance ($T(\lambda)$=80-90%) of the ZnO films, whereas the x-ray images indicated the presence of lines corresponding only to the polycrystalline ZnO phase with an average crystallite size of 12 to 15 nm [1]. The ZnO/Si heterojunction devices were produced using p-type silicon wafers with (111) crystallographic orientation and resistivity of 10 Ohm·cm. The ZnO films were deposited from zinc acetate solutions with molar concentrations of 0.1 and 0.7 mol / l. The back side of a silicon wafer was coated with a 0.5 micron-thick layer of aluminum. The front side was coated with a contact grid of gold. The cells were characterized using a PV Measurements IV-16L AAA-grade solar simulator and a QEX10 Quantum efficiency measurement system.

Finally, in order to understand the limitations, improve device performance and determine optimal device parameters, the cells were modelled using the SCAPS-1D [2] and AFORS-HET [3] tools.

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PA060

The influence of electric field applied during depositon on functionality of TiO_2/VO_2 thin films

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Multifunctional materials have been a widely researched topic in many areas, such as in electronic devices, solar cells and batteries. Therefore, intense research efforts have been devoted to develope multifunctional materials for various applications. Vanadium dioxide (VO_2), a well known functional ceramic, is the most investigated thermochromic material, which was first reported in1959*. Titanium dioxide (TiO_2) coatings have been used on glass windows and solar cells for its hydrophilic and photocatalytic properties, which are very suitable in the environments where water is readily available. Various deposition techniques like sputtering, chemical vapor deposition, molecular beam epitaxy, hydrothermal reaction and sol–gel have been used for deposition of these coatings. In comparison with other deposition techniques, spray technique offers several advantages like high deposition rate, excellent control of overall stoichiometry, and high deposition efficiency.

In this work, we have employed the spray pyrolysis technique to prepare TiO_2/VO_2 multifunctional films with suitable optical and electronic properties for application as smart surfaces. The effect of electric field on the structural, electrical, and optical properties of spray deposited TiO_2/VO_2 thin film were also investigated. The spray technique was successfully applied to produce new TiO_2/VO_2 thin films with enhanced electrical and optical properties. It was found that application of an electric field during spray deposition improves the properties of TiO_2/VO_2 thin films.

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PA061

Production of antibacterial polymeric coatings from essential oils

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[keywords] Essential oil, Rf-Pecvd, Escherichia coli, Thin film.

Plasma polymerization is a well-known technique, which is routinely used to create thin, smooth and homogenous coatings on various surfaces[1]. This technique allows fast polymerization of essential monomers, which proved to be impossible to polymerize employing the traditional coating methods. Moreover, control of the coating parameters of plasma polymerization renders possible to obtain thin films, which largely maintain the chemical properties of the parent monomer[2]. Hence, we expect the coatings of Cinnamaldehyde to exhibit strong antibacterial properties against the bacteria Escherichia coli.

First, the various substrates were cleaned and the polymeric coatings were obtained by employing radio frequency plasma enhanced chemical vapor deposition (RF-PECVD). Once the pressure in the vacuum chamber reaches down to 1 mTorr, the essential oil compounds were introduced into the chamber slowly. RF power was delivered to the chamber via two electrodes in order to create the plasma. By varying the pressure of the essential gases, RF power and the coating time we are planning to control the morphological and chemical properties of the resulting film.

Escherichia coli was produced in agars and broths. The bacteria count was determined via MacFarland standards while creating the bacteria suspension. Polymeric coatings obtained from essential oils were left with the bacteria for incubation under suitable conditions. At the end of the incubation period, the bacteria count at the mediums was compared to the bacteria count obtained from negative control experiments so as to determine the antibacterial effectiveness of the coating. Moreover, after the coated and uncoated substrates was incubated in Mueller Hinton broth containing bacteria, structure of biofilm and bacteria concentration on the surfaces of substrates were compared by taking their SEM images.

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PA062

Betavoltaic study on GaN p-i-n diode with Ni-63 source

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[keywords] Beta-voltaic, current voltage characterization.

MBE grown GaN in p-i-n structure was exposed to Ni-63 radiation to find out beta voltaic property of the structure and traced by a week though performing current voltage measurement at room temperature. It was shown that short circuit current and open circuit voltage parameters were clearly exhibited and determined as 20 nA and 300 mV respectively. These values remained constant for a week radiation exposure. Further studies are planned to access over the issue.

PA063

Determination of Contact Parameters of Al/p–Ge Diode with Methyl Green Interlayer

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[keywords] Electrical properties, organic compound, illumination effect.

Methyl green (MG) film has been grown for the first time on p–Ge semiconductor using a simple and low-cost drop coating method. The current–voltage (I–V) characteristics of Al/p–Ge and Al/MG/p–Ge diodes have been investigated in the temperature range of 20–300 K. A potential barrier height as high as 0.82 eV has been achieved for Al/MG/p–Ge diode, which has high rectification rate, at room temperature. It is seen that the barrier height of the Al/MG/p–Ge diode at the room temperature is larger than that of Al/p–Ge diode and ideality factor value of 1.14 calculated for Al/MG/p–Ge diode is lower than Al/p–Ge diode. The temperature coefficient of barrier height of the Al/MG/p–Ge diode has been calculated as 2.6 meV/K. The evaluation of current–voltage characteristics shows that the barrier height of the diode increases with the increasing temperature.

PA064

Investigation of Annealing Effects on Optical Properties of CuO Thin Films Deposited by SILAR Method

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[keywords] SILAR, CuO, thin films, annealing.

Successive Ionic Layer Adsorption and Reaction (SILAR) technique was used to deposit the CuO thin films structure at room temperature. The as-deposited film was annealed at 200, 300, and 400 ^{0}C for 30 min and the annealing effect on structural and optical properties of the films were investigated. X-ray diffraction (XRD), scanning electron microscopy (SEM), atomic force microscopy (AFM), and optical absorption spectroscopy were used for structural and optical studies.

* This research is partially supported by Erzincan University Research Foundation, Project No: FEN-A-150615-0146.

PA065

Synthesis, Characterization and Modelling of ZnSe/Zn(Cd)S/Cd(Zn)S and CdSe/Zn(Cd)S/Cd(Zn)S Core/Shell/Shell Nanocrystals

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[keywords] ZnSe/Zn(Cd)S/Cd(Zn)S and CdSe/Zn(Cd)S/Cd(Zn)S Quantum Dots, Optical characterization,

Colloidal semiconductor nanocrystals (NCs), also termed quantum dots (QDs), are composed of a core surrounded by different band gap material of its kind. With respect to core NCs, core/shell systems exhibit generally enhanced stability against photodegradation. So an important strategy to improve NCs' surface passivation is their overgrowth with a shell of a second or third semiconductor, resulting in core/shell (CS) or core/shell/shell (CSS) heterostructured nanocrystals. Furthermore, by the appropriate choice of the core and shell materials, it is possible to tune the emission wavelength in a larger spectral window than with both materials alone. In this work we report a synthetic route to prepare ZnSe/Zn(Cd)S/Cd(Zn)S and CdSe/Zn(Cd)S/Cd(Zn)S Core/Shell/Shell heterostructured NCs. The synthesized nanocrystals were characterized by using high resolution TEM, x-ray diffraction (XRD) for structural properties and UV absorption and fluorescence techniques for optical properties. An ''inverse'' quantum dot quantim well (QDQW) structure has been realized with the synthesis of CdSe/ZnS/CdS and ZnSe/ZnS/CdS NCs, as here the larger-bandgap material is embedded between the lower-bandgap ones. In the case of CdSe/CdS/ZnS, CdS as a strain-reducing intermediate shell sandwiched between the core NC and the outer shell. The interest of such structures lies in the combination of low strain, provided by the intermediate layer (CdS) serving as a ''lattice adapter'' and the outer shell (ZnS) which assures efficient passivation and charge-carrier confinement. The effects of lattice mismatch induced interface strain on the first exciton energy, capped core diameter and conduction and valence band energies of the quantum dots investigated. The induced interface strain from lattice mismatch between core and shell(multishell) calculated from continuum elastic theory and included in effective mass aproximation (EMA) to calculate corresponding capped core diameter. The results compared with bare core images from TEM to evaluate squeeze (stretch) amount in core size after compressive (tensile) shell deposition.

PA066

Produced to transition metal doped, Dy: ZnO and Dy: MgO thin fims by Chemical Spray Pyrolysis method and investigation to the thin films structures

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[keywords] Diluted magnetic semiconductors (DMSs), Dysprosium, MgO and ZnO

In the last few decades, intensive research efforts have been devoted to investigate the properties of diluted magnetic semiconductors (DMSs), which combine the advantages of ferromagnetic materials and semiconductors at room temperature [1]. Owing to the exciton spin polarization and manipulation of charge, DMSs give rise to potential applications in spintronics, such as magneto-electronic and magneto-transport devices [2]. As is known, adsorption and doping of transition metal atoms are usually efficient approaches to modulate the electronic and magnetic properties of materials, which are widely used to produce DMSs [3]. The adsorptions of transition metal on very thin film and nanotube have been studied, and the results indicated that the electronic and magnetic properties are modified due to the impurities states [4]. Also doped semiconductors show different magnetic behaviors, depending upon the type of magnetic ions, concentration of them, synthesis route and experimental conditions [5]. In this paper, we have experimentally investigated optic and structural properties Dy: ZnO and Dy: MgO thin fims. Thus Dy doped ZnO and MgO polycrystalline DMSs thin films have been prepared on glass substrates by the Chemical Spray Pyrolysis method at 450°C substrate temperature. Optical and Structural characterization of produced Dy: ZnO and Dy: MgO thin films was investigated spectral absorption and transmittance measurements by UV-Vis double beam spectrophotometer technique and XRD, SEM, EDX, AFM techniques respectively.

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PA067

Microstructure and Mechanical Behaviour of Aluminium Oxide Thin Films

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[keywords] Aluminium, Oxide aluminium, Anodizing..

In the last few years, Aluminium alloys are widely used in aircraft structures due to theirs light weight and high specific strength [1]. Alloying with addition elements improves mechanical properties of the alloy, but decreases their chemical properties due to microstructure effect [2]. for this purpose, anodizing of different aluminium alloys in electolytical acid bath has traditionally been used. Anodizing process successfully combines science with nature to create a best finishes to parts of aluminium alloys. It is an electrochemical process that thickens and toughens the naturally occurring protective oxide. Aluminum alloys parts mounted to the inside of the anodizing tank as anode received the oxygen ions that are released from the electrolyte to combine with the aluminum atoms on the surface of the workpiece is anodized. This process is realized by immersing parts of aluminum allowys into an heated acid electrolyte bath and passing an electric current through the medium during a definite time. This treatment yields coatings usually varied at point of view of thickness and properties, depending on the choice of different technological parameters used for this process. The objective of this work is to study the influence of the immersion time as technological parameter on the thikness, the structure, morphology and the hardness of thin layer compound obtained by anodization. Aluminium alloy used as substrate which is employed for erea of manufacturing industry belongs to series of 6000. Prior to be anodized, the specimens used in manufacturing industry field were subjected to series of surface preparation. The specimens were polished, degreased and dipped. After each step of the surface preparation, the specimens were rinsed. In electrolytic solution, anodizing steep was carried out in the presence of sulfphuric acid for different immersion time. The chemical reactions which take place between aluminium alloy and electrolytical solution give rise to the formation of metallic compounds layers. The structure of these solid solution layers was identified by X ray diffraction. The morphology and thickness of coatings obtaine at different immersion time took place with optical microscope. Finally the hardness of coatings was measured with a Vickers hardness tester.

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PA068

Dopant Concentration Effects on Mn-Doped ZnO Thin Films

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Keywords: Thin films; Cu doped ZnS; Chemical deposition; Optical properties

Doping of semiconductors leads to better thermal and chemical stability, larger stokes shift between absorption and emission peaks and enhancement of emission color tunability [1-3]. Mn-doped ZnO films have been prepared by chemical deposition method at 75 °C. The XRD pattern reveals that the films exhibited hexagonal crystal. SEM images show the surface uniformity is good and the hexagonal columnar shapes have well adherent onto the substrate vertically. The following peaks are observed in the photoluminescence spectra; a shoulder around 398 nm attributed to band gap emission [4], a peak position at 424 nm is likely due to photo-generated hole in valence band and electron in zinc interstitial [5], the more intense peaks located around 486 nm and 530 nm are the recombination possibilities through oxygen vacancy and oxygen antisite, in sequence. Furthermore, relatively intense peak around 572 nm is characteristic of Mn dopant levels [6]. It was clear that the PL intensity of the films is strongly dependent on doping level and intensity of the orange peak around 572 nm corresponding to Mn dopant levels increased significantly with increasing Mn^{2+} concentration, and showed a maximum when the Mn^{2+} to Zn^{2+} molar ratio was 1 in the precursor solutions.

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PA069

Tailored Protein Adsorption on Biocompatible Plasma Nanofilms

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[keywords] biocompatibility, biomedical, PECVD, magnetron, plasma polymerization, nanofilms

In the development of biocompatible materials for biomedical applications a tailored foreign body response is an important issue. The healing of surrounding tissue often interferes with the function of an implant. Events like protein deposition, foreign body response, infections and the unwanted encapsulation of the implant are the main causes of failure of implanted devices. [1], [5], [6], [8]

In this study biocompatible nano-films are produced by means of a plasma polymerization process using a low-pressure magnetron-enhanced 15 kHz glow discharge. This process allows the precise control of the film properties and behavior. [3] The resulting hydrocarbon film has a thickness of only a few nanometers and thus does not influence the inherent properties of the substrate material. [4], [7]

Apart from different surface analytical methods, the interaction with different biological sample materials was tested. The precise measurement of the adsorbed protein layer indicated a native secondary structure of proteins on these surfaces. These Measurements of protein adsorption helped tailoring the thin films in the needed direction. Especially the secondary structure of adsorbed proteins was modified to produce highly biocompatible interfaces and therefore control the foreign body response.

Different in-vivo sensor dummies in contact with blood and soft-tissue were coated by nano-films. The native secondary structure of proteins kept the implanted sensors free of any encapsulation by a plasma nano-film coating. [2]

The measurement results of the adsorption of blood proteins indicated that these nanofilms already have a very biocompatible character. The in-vivo testing of coated sensors showed that they were kept free of any encapsulation. These groundbreaking coatings open the door for many new applications in the field of a lot of biomedical products.

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PA070

Synergistic Tungsten Oxide/Conducting Polymer Hybrid Nanofiber Assemblies for Highly Efficient Electrochromic Devices

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[keywords] tungsten oxide, conducting polymer, ionic liquid, chemical synthesis, hybrid nanofiber, electrochromic device

We report the first successful applications of tungsten oxide/conducting polymer hybrid nanofiber assemblies in electrochromic devices. Poly(3,4-ethylenedioxythiophene)/tungsten oxide (PEDOT/WO_3) and polypyrrole/tungsten oxide (PPy/WO_3) composites were prepared by an *in situ* chemical oxidative polymerization of monomers in different ionic liquids; 1-butyl-3-methylimidazolium tetrafluoroborate ($BMIMBF_4$), 1-butyl-3-methylimidazolium hexafluorophosphate ($BMIMPF_6$), 1-butyl-3-methylimidazolium bis(trifluoromethylsulfonyl) imide (BMIMTFSI) and 1-butyl-1-methylpyrrolidinium bis(trifluoromethylsulfonyl) imide (BMPTFSI). Electrospinning process was used to form hybrid nanofibers from chemically synthesized nanostructures. The electrospun hybrid samples were compared from both morphological and electrochemical perspectives. Importantly, through application of the methodology presented in this study, deposition of nanofibers from chemically synthesized hybrids can be achieved homogenously, on nanoscale dimensions. The morphology and structural properties of these assemblies were evaluated by SEM and EDX spectroscopy, whereas their electroactivity was characterized by cyclic voltammetry. Electrochromic devices made from hybrid nanofiber electrodes exhibited highest chromatic contrast of 37.66% for PEDOT/WO_3/$BMIMPF_6$, 40.42% for PPy/WO_3/$BMIMBF_4$ and show a strong electrochromic color change from transparent to light brown. Moreover, the nanofiber devices display excellent stability when color switching continues, which may provide a versatile and promising platform for color displays, rear-view mirrors and smart windows [1]. The electrospinning approach and utilizing electrode materials that have intrinsic electrochemical color-change properties are concepts that can be readily extended to other electrochromic materials [2].

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PA071

Electrochemical Preparation of Poly(2-chloroaniline) and poly(aniline-co-2-chloroaniline)Modified ZnFe Films on Carbon Steel Surface and Their Corrosion Performance

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[Keywords] Conducting polymers, ZnFe, corrosion

Among the other protective coatings, zinc and zinc alloys (ZnFe, ZnCo, ZnNi) are widely used on steel. Zinc alloys improved corrosion resistance compared to pure zinc in the protection of ferrous-based metals. This is easily achieved by alloying Zn with more noble metals such as Fe, Ni and Co. Among iron group-zinc alloy coatings, zinc-iron (ZnFe) alloys have attracted considerable attention due to their excellent corrosion resistance, formability and good paintability [1-2].

In this study, zinc–iron (ZnFe) alloy plating was successfully deposited on carbon steel (CS) applying current of 3 mA with galvanostatic technique. Poly(2-chloroaniline) and poly(aniline-co-2-chloroaniline) films were synthesized with cyclic voltammetry technique from 0.20 M sodium oxalate solution on zinc–iron plated carbon steel (CS/ZnFe) electrode. The characterization of ZnFe deposited carbon steel electrodes with and without poly(2-chloroaniline) and poly(aniline-co-2-chloroaniline) films have been investigated by using AC impedance spectroscopy (EIS) technique, linear sweep voltametry (LCV) technique, anodic polarization curves and scanning electron microscopy (SEM). The results showed that copolymer film coated electrode exhibited good anticorrosive properties than homopolymer and alloy coated electrodes

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PA072

Interface Analysis of HfO_2 Thin Film Grown on Si by RF Magnetron Sputtering Technique

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[keywords] HfO_2, High κ, XPS, SE, Magnetron Sputtering.

Hafnium dioxide is a good candidate for applications in next generation metal-oxide-semiconductor (MOS) technology due to its high dielectric constant (κ =25) [1], reasonable energy bandgap (E_g >5 eV) [2] and thermodynamic stability on Si substrate. The performance of HfO_2 as a high-κ gate dielectric material depends strongly on the occurrence of interfacial silicate layers, which will decrease the overall dielectric constant. Therefore, the atomic ratio of Si to Hf is an important issue for HfO_2/Si structure. Although there are various interfacial studies for HfO_2 film in the literature, there is a lack concerning the identification of interfacial layer in HfO_2/Hf/Si system by an optical depth profiling technique. In this work, in-situ spectroscopic ellipsometry (SE) which is mounted onto the magnetron sputtering system is used to define the initial growth properties of HfO_2 film on Si (100) substrate under 30 W rf power and 0.4 O_2/Ar gas ratio. The thickness evolvement of HfO_2 and variation of interfacial SiO_x were detected by this technique. SE depth profiling measurements revealed that Hf metal atoms consumed some of the oxygen of Si native oxide just leaving HfO_2 and Si behind. In addition to this, interface analysis was obtained by X-Ray Photoelectron Spectroscopy (XPS) which bared that the grown film is not in homogeneous form.

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PA073

Fabrication of Cu_2ZnSnS_4 Absorber Layer on Flexible Titanium Foil Substrate for Thin Film Solar Cell Applications

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[keywords] CZTS, Thin film solar cells, Flexible substrate, Sputtering

Cu_2ZnSnS_4 (CZTS) as an absorber layer for thin film solar cells is a promising candidate due to its low cost and nontoxic properties unlike CdTe and $Cu(In,Ge)Se_2$ (CIGS). CZTS has a direct bandgap of 1.4-1.6 eV and a large optical absorption coefficient of about 10^4 cm^{-1}. Therefore, CZTS is an ideal absorber layer material for photovoltaic devices [1]. Beside these advantages, the components of CZTS are earth abundant and less toxic when it is compared with CIGS [2]. The theoretical limit of power conversion efficiency, 32.3%, has been calculated by using Shockley–Quiesser photon balance calculation. Until now, the CIGS based thin film solar cells is better power conversion efficiency of 20.3% and the highest power conversion efficiency for CZTS has been achieved as 12.6% [3, 4], due to this comparable value has been started to investigate for CZTS by various research groups. Substrate material, on which absorber layer coated, should be nonreactive and resistant to the mechanical effects through producing. Furthermore, its thermal expansion should be similar to the adjacent p-type semiconducting layer. Molybdenum is a preferred element that is used as back contact layer [5], but recent studies has showed that Mo back contact has detrimental effects in CZTS solar cells [6]. Therefore, Ti foil back contact causes less crack formation than Mo back contact [7]. For this reason we preferred the Ti foil as a substrate. Moreover when Ti foil is used as a substrate, any other back contact is not required because of its metallic property.

In this study, CZTS layer was fabricated with by dc magnetron sputtering. The sputtering parameters were optimized for each layer to obtain the desired thickness. Metallic precursor was sputtered Zn, Sn, Cu layer respectively. After sputtering, the following process is the sulfurization of these metallic precursors in the Argon (Ar) atmosphere above 500 ^oC by using sulfur powder. For sulfurization two steps were used; first step is pre-annealing, the metallic precursor was placed to cover sulfur powder in graphite box and it was smeared to the 270 ^oC zone. Second step is sulfurization, the graphite box was smeared from 270 ^oC to 550 ^oC. Then the sample was cooled down naturally to the room temperature in furnace. Structural characterizations of our samples were done through Raman Spectroscopy, EDS and XRD analysis. The sample's crystallinity and grain compactness of the film was determined by scanning electron microscopy (SEM).

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POSTER SESSION B

PB001

Enhancement Of Hıgh-Carbon Steel Surface Propertıes Through Pulse Plasma Technıque

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Keywords**:** Pulse plasma, DIN 1.2210, surface modification, hardness, linear wear

In this work, the surface of DIN 1.2210 steel were modified by a developed plasma pulse technique. It was determined that pulse plasma process parameters affect the thickness of modification layer and its microstructure. SEM and EDS analysis is also made of modified surfaces. XRD analyses and microhardness testing were applied on surface. FeN, Fe_2N, W_3O, α-Fe, γ-Fe phases were detected in modification layer. Microstructural hardness measurements were taken from surface to core and different values were measured depending on various parameters. The hardness of steel sample was measured as 170-180 HV before pulse plasma treatment. Its value was increased to 1776 HV after treatment. Wear test was done in CSM-linear wear test machine with 0.05 m/s speeds under 5 N constant load for 200 m. It was observed that friction coefficient and wear value were changed in accordance with speed. Worn surfaces of specimens were studied by SEM and EDS analyses techiques.

PB002

Theoretical Determination of the Refractive Index and Extinction Coefficient of an Absorbing Thin Film by Using Morse Wavelet

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[keywords] Refractive Index, Extinction Coefficient, Absorbing Thin Film, Morse Wavelet, Transmittance.

The optical constants of an absorbing film, such as refractive index and extinction coefficient are the significant parameters for the production and improvement of the optic and optoelectronic devices. Therefore, many methods have been improved for the determination of these parameters [1-4]. In this work, the Continuous Wavelet Transform with Morse wavelet was improved as a tool to determine the refractive index and extinction coefficient of an absorbing film by using the transmittance spectrum. A transmittance spectrum with 300-1200 nm wavelength interval was theoretically generated and it was analyzed by Morse wavelet. The dispersion curve of refractive index and extinction coefficient were obtained and refractive index data were fitted to Cauchy formula, whereby the dispersion parameters were extracted. The obtained results were also compared with the results obtained by envelope method [2] and input values, and the advantages and disadvantages of the presented method was discussed. The noise immunity was also studied.

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PB003

Nanostructured Diamond-like Carbon Thin Films Growth on Stainless Steel

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[keywords] diamond-like carbon, thin films, CVD processes, aligned growth, nanomaterials.

Diamond-like carbon (DLC) is an amorphous form of carbon that may contain a high fraction of sp^3-hybridized carbon atoms. DLC films possess a combination of attractive properties and have been largely employed to modify the tribological behavior of materials. Nanostructured DLC films are the new generation of these coatings providing tremendous potential to modify and tailor properties expanding their applications in the field of nanotechnology [1]. The present study investigates the properties of nanostructured DLC thin films on stainless steel substrates by chemical vapor deposition. The presence of nanostructures in the DLC films promote special characteristics for the DLC films growth on metallic substrates. Nanostructured DLC films were obtained using pure methane plasma processes at room temperature. The substrates used to deposit the films were rectangular plates of stainless steel. Before the carbon thin film growth, the samples were submitted to a chemical cleaning step and we growth a thin layer of iron by Magnetron Sputtering on the stainless steel substrates to serve as a seed (nuclei). The parameters of the DLC films depositions were: 15 mTorr, 250 W (coil power, RF, 13.56 MHz, remote plasma), 40-sccm methane and the final time deposition was 3 hours. The nanostructured DLC films were analyzed by SEM, Far-FTIR, ATR-FTIR and Raman spectroscopy. Nanostructured DLC thin films obtained in work showed carbon nanotubes and fullerenes in their amorphous matrix. The results showed low carbon amorphous content in the matrix of nanostructured DLC thin films and high-alignment of the nanostructures formed in the DLC films. The roughness of these films are low and the presence of carbono nanotubes improve the features of the stainless steel substrates promoting a large variety of applications, including biological application.

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PB004

Electro- optical characterization of amorphous niobium oxide deposited by RF magnetron sputtering

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[keywords] Sputtering photocurrent deposition diode.

Niobium oxide thin films have a wide variety of applications and various techniques to be obtained [1,2]. In this work, amorphous niobium oxide thin films were deposited in a home building RF-magnetron sputtering through niobium target, 150 mm diameter, and oxygen and argon plasmas. The niobium target and oxygen purities were 99 % and 99.999 %, respectively. The pressure was maintained at 10 mTorr with different oxygen percentages (5, 10, 20 and 40%) for the same process time – 30 minutes, the target-substrate distance was 10 cm, the substrate temperature was maintained constant and the niobium oxide thin films were deposited, in RF power (13.56 MHz) of 200 W, on silicon (100, p type) wafers. The films were analysed by the following techniques: spectral reflectance for thickness and refractive index, Rutherford Back Scattering for Nb/O ratio, near Fourier Transformed Infra Red for chemical analysis, X-ray diffraction, C-V (capacitance – voltage) for dielectric constant determination and I-V (current – voltage) for photoconductivity. All samples showed to be amorphous in the temperature process, lower than 150 ^{o}C. Niobium oxide shows crystalline structure when annealed at 500 ^{o}C [3]. Independent of the oxygen concentration in the process, the films showed a very close stoichiometry, Nb/O ratio, 0.36 the lowest value and 0.39 the highest value. So, the thin films can be considered as Nb_2O_5. In spite of the FTIR results did not show any Nb-O bonds, indirectly was possible to conclude that there were Nb-O bonds because all films were transparent to infrared light. For electrical analyses Al (500 nm)/film/Si/Al (backside) capacitors were fabricated. The films showed a low dielectric constant, 20 - 30, when compared with literature, 200 [4]. Concerning to I-V measurements, the semiconducting type was n for all samples and when illuminated showed high sensitivity when exposed to white light.

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PB005

Investigation of Material Properties of Magnetron Sputtered Cu-Ag-In-Se Thin Films

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[keywords] thin film, annealing, nanostructure.

Thin films of copper based chalcopyrite absorber materials are attracting the attention of many researchers because of their favorable optoelectronic properties and good stability makes them suitable for photovoltaic and optoelectronic device applications. These compounds are particularly suitable for making p-n hetero-junctions with the II-VI compounds. Therefore, the utilization of I-III-VI_2 group of chalcopyrite semiconductors has been reported in the literature for application in thin film solar cells. In this work, the quaternary structure Cu-Ag-In-Se (CAIS) that belongs to the ternary semiconducting I-III-VI_2 materials family formed by occupying the Cu sites alternatively with Ag has been investigated. CAIS thin films were prepared by using a magnetron DC/RF sputtering system, and CIS and Ag targets were used in the deposition process of the CAIS thin films in stacked layer formation to get a homogenous film structure. In fact, the work has been particularly concentrated on the wire-shaped formations on the CAIS film surfaces for the forms of as-deposited and thermally annealed at different temperatures. The characterizations of the thin films were done by X-ray diffraction (XRD), and also scanning electron microscope (SEM) equipped with energy dispersive X-ray analysis (EDXA) detector facility. The surface characteristics were investigated by SEM measurements and the observed nanostructures were detailed. Moreover, the complementary characterization of the films includes transmission and reflection measurements for optical; room temperature resistivity measurements and temperature dependent conductivity for electrical analysis.

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PB006

Phthalocyanine as a Sensitive Material for Organic Vapour Detection using Acoustic Wave Based Sensors

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[Keywords] Quartz Crystal Microbalance, Zinc Phthalocyanine, gas sensor.

The standard Quartz Crystal Resonator (QCR) and network analysis based methods in conjunction with curve fitting were used to investigate the sensing capability and characterize the properties of phthalocyanine films on vapour exposure. The measurement of frequency shift and resistance change (mass loading and film damping) [1], caused by adsorption of organic vapour namely, Benzene, Hexane, Ethanol and Toluene were investigated. Confirmation of film properties using supplementary methods such as AFM, Ellipsometry and UV-visible spectrometer was also performed to provide a full characterization of the sensing membranes.

Film thickness was obtained by Ellipsometry and subsequent fitting procedures. Additionally, investigation of Phthalocyanine film morphology was carried out using AFM measurements, where AFM measurements in tapping mode have been implemented on all samples in this study. Typical features and corresponding cross-sections of phthalocyanine films deposited onto silicon substrates are presented and the roughness analysis of the AFM images has been performed.

The Zinc phthalocyanine (ZnPc) film [2] was found highly sensitive with detection limits in the low parts-per million range for the selected analytes. Furthermore, a comparison of gas sensor responses for the selected materials is included, and consequently a particular type of substituent is proposed as a suitable sensor coating for Quartz Crystal Microbalance (QCM) gas sensor applications.

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PB007

Effect of hydrogenation on defect density and electrical properties of CdTe

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[keywords] Hydrogenation, Surface passivation, Annealing, CdTe, EPD, Raman.

CdTe is a direct-gap semiconductor with potential applications for photo-detectors and solar cell applications. Crystal quality and surface structure of CdTe epitaxial layers have important role on CdTe based device performances. Especially, high surface defects density may cause leakage currents which reduces CdTe based device efficiency. Surface passivation method can be employed to stabilize surface defects while surface passivation with hydrogen results defect reduction on crystal surfaces which has been used for decades[1]. Hydrogen passivation of crystal surfaces with atomic hydrogen sources may cause profound modifications in the electrical and optical properties of these materials[2]. It has been reported that passivation of interband states resulted in a reduction in the resistivity to about 10^5 Ω cm from ~ 10^{16} Ω cm[3]. On the other hand, P. Boieriu et al. shown reduction in defect density after hydrogenation[4]. In this study, CdTe single crystal thin films were grown with molecular beam epitaxy (MBE). Surface hydrogenation method was applied to reduce the density of structural defects on MBE grown CdTe layers. Atomic hydrogen source was obtained with hot filament method under vacuum conditions. Additionally, CdTe films were heated during the hydrogen passivation process. CdTe surface and crystal quality were determined with defect decorating Everson etching method before and after the hydrogenation process. Defect density (Etch pit density, EPD) was then calculated from scanning electron microscopy (SEM) and Nomarski contrast microscopy images. Additionally, I-V measurements were performed in order to determine resistivity of the samples.

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PB008

Molecular Beam Epitaxial Growth of ZnSe on (211)B GaAs

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[keywords] MBE, ZnSe, XRD, AFM, Nomarski, Raman.

CdTe is grown as a buffer layer between ternary alloy and an alternative subsrate. This buffer layer plays an important role to reduce dislocations due to large lattice mismatch between the ternary alloy grown on GaAs or other alternative substrates such as Si and Ge [1]. The crystal quality and defect content of CdTe buffer layer directly affects the quality of ternary alloy. Therefore, CdTe needed to be of low defect density. However, the lattice mismatch between GaAs and CdTe is %14.6 [2]. Because of this, large number of defects appear in CdTe buffer layer. A ZnSe interlayer can be used to decrease lattice mismatch between CdTe and substrate. Once ZnSe interlayers are grown with high quality, the properties of CdTe can be improved dramatically. In this study, ZnSe films have been grown on (211) GaAs substrates by molecular beam epitaxy (MBE). The effect of growth temperature,VI/II flux ratio on the crystal quality were investigated by using X-ray diffraction. In addition,vibrational phonon modes, thermal and elastic strains of ZnSe interlayers were obtained by Raman spectroscopy [3]. The surface morphology of ZnSe films were analyzed by atomic force microscopy and Nomarski microscopy.

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PB009

Characterization of Metal(Ag, Au)/Pc thin film/Semiconductor Structures by Impedance Spectroscopy Technique

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Metal-insulator-semiconductor (MIS) structures play an important role role in modern semiconductor technology as the basis of a large number of electronic devices such as field-effect transistors, solar cells and photodetectors. The performance of the MIS based device is known by the performance of an insulator layer in terms of charge storage/unit area value. Generally, silicon dioxide (SiO_2) has been used as the gate dielectric in MIS based devices. Recent studies showed that the desired down-scaling and performance enhancements of MIS based devices require the replacement of the SiO_2 layer with other dielectrics possessing stable, low leakage and high permittivity dielectric thin films. Organic materials, such as phthalocyanines (Pcs), which combine the electrical properties of conventional inorganic semiconductors and the versatility of organic chemistry, have attracted much attention.

In the present work, we focused on studying the potentiality of the phthalocyanine thin film for use in Au/insulator (Pc)/n-Si and Ag/insulator (Pc)/n-Si Schottky barrier diode as insulator layer. The charge transport mechanism and dielectric parameters determined from the measured current-voltage, capacitance–voltage and impedance spectra. The effect of the temperature on the impedance spectra of the structures were also investigated. The non-linear behavior of ln (I) *vs.* ln (V) and ln (I) *vs.* V plots indicated that the bulk limited Poole–Frenkel emission can be applied to evaluate junction parameters under forward biase conditions. Frequency and temperature dependence of the ac conductivity have been analyzed in terms of

classical models based on pair approximation. From the measured impedance, Non-Debye type relaxation process was observed.

PB010

An investigation on characterization of ZnO/p-GaAs structure synthesized by sol-gel technique

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[keywords] ZnO/GaAs, heterodiode, sol-gel, AFM, thin films.

In this investigation, n-ZnO/p-GaAs structure is prepared by a sol-gel route. ZnO film has wurtzite structure with (101) preferential direction. The nano-sized particles are homogeneously dispersed on the film surface. The RMS roughness and optical band gap values are determined to be 11.49 nm and 3.272 eV. The electrical study shows that n-ZnO/p-GaAs structure has a rectifying property under the dark. The ideality factor and barrier height of structure are defined to be 1.52 and 0.92 eV, respectively. The outcomes obtained from present study remark n-ZnO/p-GaAs structure should be utilized for a variety of applications.

PB011

Investigation of Thermally Grown Oxide (TGO) Growth Behaviors of Single and Double Layered Rare Earth Zirconates under Isothermal Oxidation Conditions

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[keywords] Thermal barrier coating (TBC), Oxidation, Thermally grown oxide (TGO), EB-PVD, HVOF, CoNiCrAlY, Rare earth zirconates.

Oxidation is an inevitable failure mechanism under the operation temperature in gas turbines. To avoid negative effects of oxidation, ceramic based materials having low thermal conductivity and high stability should be used to hot section components [1]. In accordance with this purpose, thermal barrier coatings (TBCs) are used in order to increase lifetime of gas turbine engine components which have not reached to desired levels yet [2]. Yttria Stabilized Zirconia (YSZ) has been used as conventional top coat material in TBCs. Increased turbine inlet temperatures promotes to researchers to try higher stable material such as rare earth zirconates [3]. In the present study, CoNiCrAlY metallic powders were sprayed using high velocity oxygen-fuel (HVOF) technique on Inconel 718 substrates. $Gd_2Zr_2O_7$ and $Gd_2Zr_2O_7$/YSZ were deposited by Electron Beam Physical Vapor Deposition (EB-PVD) technique as top coat materials. In high temperature furnace, both TBC samples were isothermally oxidized at 1000 °C under different time periods. TBCs were examined as microstructural before and after oxidation tests. Thermally grown oxide (TGO) layer forming at the interface during oxidation were investigated and compared for each TBC systems. Oxidation and TGO growth behaviors were discussed.

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PB012

Comparison of Hot Corrosion Behavior of YSZ and YSZ/$La_2Zr_2O_7$ Double Layer Thermal Barrier Coatings (TBCs) Exposed to Na_2SO_4 and V_2O_5 Salts

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[keywords] Thermal barrier coatings (TBCs), Hot corrosion, Cold Gas Dynamic Spray (CGDS), Electron Beam Physical Vapor Deposition (EB-PVD), YSZ, $La_2Zr_2O_7$, Na_2SO_4, V_2O_5

Thermal barrier coatings (TBCs) are extensively used to protect critical part components in aircraft engine components. Aircraft fuels used in energy generation systems contains complex mixtures of molten salts such as vanadium oxide (V_2O_5) and sodium sulfate (Na_2SO_4) [1]. These molten salts causing severe hot corrosion damage at high temperatures due to chemical reaction to gas turbine engine components like blades and vanes [2]. Yttria stabilized zirconia (YSZ) is conventional top coat material for TBCs [3]. Lanthanum zirconate ($La_2Zr_2O_7$) is a promising new TBCs material due to its low thermal conductivity and high temperature stability.In this study, CoNiCrAlY metallic bond coats were deposited on Inconel 718 superalloy substrate using promising new technique called as Cold Gas Dynamic Spray (CGDS). Following the application of the bond coat production, ceramic top coats produced by Electron Beam Physical Vapor Deposition (EB-PVD) technique with YSZ and YSZ/$La_2Zr_2O_7$ double layer ceramic top coating materials. Single and double layer TBC systems were exposed to hot corrosion tests with 50 wt.% Na_2SO_4 and 50 wt.% V_2O_5 molten salt mixtures at 1000°C temperature. TBC systems were characterized and compared from the point of microstructural change, hot corrosion products and phase transformations.

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PB013

Dielectric and Electrical Properties of lead-free $Bi_{0.5}Na_{0.5}TiO_3$: $BaTiO_3$ (BNT-BT) Ferroelectric Thin Films by Pulse Laser Deposition

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[keywords] lead free, dielectric, piezoelectric, electrical conductivity.

A lead-free ferroelectric and piezoelectric materials have been studied as an important material for environmental protection. $Bi_{0.5}Na_{0.5}TiO_3$ (BNT) based ceramics and thin films are thought to be one of the candidates as the lead-free alternative systems. However, the growth of NBT based ceramics and thin film is very difficult due to the high volatility of the (Na, Bi) ions in high sintering temperature. Through the control of Na and Bi composition, 6mol% BT substituted BNT-BT thin films were successfully prepared by a pulse laser deposition method. The dielectric property and electrical conductivity of BNT-BT thin film were investigated up to 600 ^{o}C over the frequency range of 1 Hz ~ 1 MHz. With increasing temperature, the frequency dependences of the real and the imaginary parts of the dielectric constant had a frequency dependent dielectric dispersion. The temperature dependences of the ac conductivities could be described by an Arrhenius relation; □□□□□□□□□□exp($-E_a/kT$), and activation energy E_a for conduction process is obtained. In this work, the preparation, dielectric and electrical property of lead free BNT-BT ferroelectric thin films were investigated by a dielectric constant, ferroelectric P-E hysteresis loop and electrical conductivity.

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PB014

Dimethylamine Borane Oxidation At Metal Nanoparticles Modified Composite Polymer Electrode

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[keywords] Dimethylamine borane oxidation, metal nanoparticles, polymer film electrode, fuel cell

Dimethylamine borane (DMAB) has amine odor with a chemical formula of $(CH_3)_2NH:BH_3$ [1]. DMAB is used in wide range of applications as a reductant [2] and also used as a fuel in fuel cell applications [3]. Fuel cells convert chemical energy stored in fuels to electrical energy and therefore, require a constant source of fuel to sustain the chemical reaction [4] which are environmentally friendly than fossil fuels. Present work describes the electrochemical fabrication of a poly(p-aminophenol) film glassy carbon electrode (PAP/GCE) which decorated electrochemically with metal nanoparticles (MNPs) for the investigation of DMAB oxidation that is used in fuel cell applications as a fuel in alkaline solutions. The Au/Ag nanoparticles modified PAP/GCE electrode surface was characterized with SEM, EDX, TEM, XPS and EIS. Experimental parameters both in electropolymerization and DMAB oxidation were optimized and the results of electrocatalytic oxidation of DMAB at the metal nanoparticles modified composite polymer film electrode was compared with those obtained with bare GC, PAP/GCE.

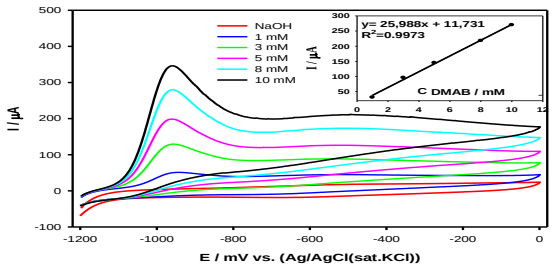

Figure 1. Cyclic voltammograms of Background response in 2 M NaOH and 1 mM to 10 mM DMAB oxidation at MNPs/PAP/GCE. Inset: plot for the peak current of MNPs/PAP/GCE versus the concentration of DMAB.

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PB015

Tribological and Corrosion behavior of Cu/Al_2O_3/Graphene Hybrid Nanocomposites Produced by Electroless Coating

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[keywords] electroless copper coating, graphene, friction, solid lubrication, wear mechanisms, corrosion

Metal matrix composite coatings containing nano-sized particles of reinforcing phase can be effectively deposited by electroless to enhance the corrosion and wear properties of materials. Particles are generally classified into two types, namely, solid lubricants and hard particles. Solid lubricants usually reduce the friction coefficient. On the other hand, hard particles have increased mechanical and corrosion properties and wear resistance because of their high microhardness and chemical stability [1,2]. Graphene is a new carbon nanomaterial that exhibits mechanical properties with better performance than CNT.

In this study, Cu/Al_2O_3/Graphene composite coating was deposited on the surface of steel by electroless plating. Graphene as a conductive solid lubricant additive were introduced into Cu matrix from the bath in which submicron Al_2O_3 particles and graphene nanosheets were suspended. The main purpose for two different reinforcement co-deposition process is to improve the tribological properties while maintaining good electrical conductivity. The composition and microstructure of the composite coating were performed by EDX (energy-dispersive analysis), SEM (scanning electron microscope) and XRD (X-ray diffraction). The corrosion resistance, microhardness and the wear resistance of the Cu/Al_2O_3/Graphene composite coatings were measured. The friction and wear behaviors of Cu/Al_2O_3/Graphene composite coatings on the steel against Al_2O_3 ball were tested under dry sliding wear conditions. The corrosion behavior of the Cu/Al_2O_3/Graphene composite coating were evaluated through polarization curves and electrochemical impedance spectroscopy (EIS) in 3.5 wt.% NaCl aqueous solution at the room temperature. The results indicated that the incorporation of graphene in the coating improved both tribological behavior and corrosion resistance.

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PB016

Characterization of K and Mg Co-Doped BST Thin Films with $SrTiO_3$ Buffer Layers in Cross-Over Concentration Design

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[keywords] BST, Cross-over Concentration, ST Buffer Layer

Cross-over concentration of K/Mg co-doped BST thin films with $SrTiO_3$(ST) buffer layers were designed and prepared by sol-gel method on Pt/Ti/SiO_2/Si substrates, and their structures and dielectric properties have been studied. Pure BST films and 5% K or Mg doped BST films were also studied for comparison. The K/Mg co-doping concentration has a strong positive influence on the microstructure and dielectric properties of BST films. X-ray diffractions reveal that all films grow along (110) orientation and show polycrystalline cubic perovskite structures. SEM investigations show that all the films with ST buffer layers have dense and crack-free surfaces and exhibit smaller grain size and better uniformity than the pure BST film. Through cross-over study design, 2%K/2%Mg co-doped BST film achieves significantly high tunable capability of 52.3% at low applied voltage of ±10V, low dielectric loss of 0.008, and figure of merit (FOM) of 65.4, which can fulfill applications in tunable microwave devices. Therefore, K and Mg with optimum concentration and novel structure design by insertions of ST buffer layers can significantly improve the dielectric properties of BST materials.

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PB017

Spectroscopic Study of Film Formation From PS Latex/AgNPs Composites

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[keywords] PS latex; Ag nanoparticles; Film Formation; Fluorescence; Composites.

In this study, we investigated the characteristic change in film formation, optical, morphological and electrical properties of pyrene (P) labeled polystyrene (PS) latex/silver nanoparticles (AgNPs) (PS/AgNPs) composites using steady state (SSF) and fast transient (FTRF) fluorescence techniques in conjunction with UV–vis (UVV) technique. Nine different mixtures were prepared by mixing of PS latex dispersion with different amount of AgNPs in the range of (0- 50 wt%). PS/AgNPs films were then prepared on glass substrates using drop casting method and drying at room temperature. After drying, film samples were separately annealed above glass transition temperature (T_g) of PS ranging from 100 to 280 ^{0}C for 10 min. In order to monitor film formation process, fluorescence emission spectra, fluorescence decay curves and transmittances of these composites were measured after each annealing step as a function of AgNPs content. The emission spectrum became narrower [1] depending on the AgNPs content in the range of (3-30) wt%. Fluorescence enhancement and reduced lifetime were also observed with increasing AgNPs content in this range [2]. However, the fluorescence emission spectrum remained almost unchanged and the intensity decreased substantialy with annealing temperature with increasing AgNPs content above 30 wt%. For (3-30) wt% AgNPs content, fluorescence intensities (I_P) from P and transmitted light intensity (I_{tr}) through the films were measured after each annealing step. Below 30 wt% AgNPs, two distinct film formation stages, which are named as void closure and interdiffusion processes, were seen in fluorescence data [3]. However, above 30 wt%, no change was observed in I_P and I_{tr} upon annealing, whereas transparency decreased overall with increasing AgNPs content. The electrical conductivity of these composites was measured as a function of AgNPs content. In the studied concentration range (0-50 wt%) of AgNPs very little increase in electrical conductivity was observed.

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PB018

Nanostructural and Optical Properties of TiO2 Films Grown By Reactive RF Magnetron Sputtering as a Function of Oxygen Flow Rate

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[keywords] TiO_2 films; RF reactive magnetron sputtering; XRD; AFM; Swanepoel

Titanium dioxide films of 300 nm thickness were deposited by reactive RF magnetron sputtering at a high sputtering pressure and room temperature on glass substrates. TiO_2 films were under a constant power, but different $O_2/Ar+O_2$ ratios in the sputtering ambient from 0 to 0.3. The crystallography and surface morphology of the films were obtained using X-ray diffraction (XRD) and atomic force microscopy (AFM) respectively. It was observed that TiO_2 films grew in anatase phase. Transmission spectra of TiO_2 films between 340 and 850 nm wavelength were collected. Refractive indices and the thickness of samples obtained using Swanepoel method. Optimum packing density and the highest refractive index were obtained for the sample prepared at $O_2/Ar+O_2$ ratio of 0.2.

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PB019

In-situ MgB_2 thin film fabrication on commercial Ni- tapes by e-beam evaporation and their electrical performance

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Keywords: MgB_2 thin film, in- situ, e-beam evaporation

MgB_2 films on commercial Ni tapes were fabricated by in- situ e-beam evaporation technique using pure B and Mg target. The flux rate of Mg and B were chosen as 3 nm/ sn and 0.5 nm/ sn respectively with different substrate temperature. According to temperature dependent resistivity data, we found that the substrate temperature can strongly affect the superconducting properties of the films as seen in the figure 1. The surface morphology and AFM images of the films were analyzed and it was found that the surface morphology strongly depends on the fabrication conditions. The transport critical current density for different temperatures and the J_c-T under different low magnetic fields were analyzed. We found that magnetic Ni substrate have a positive effect on the critical current density which can be useful for technological applications.

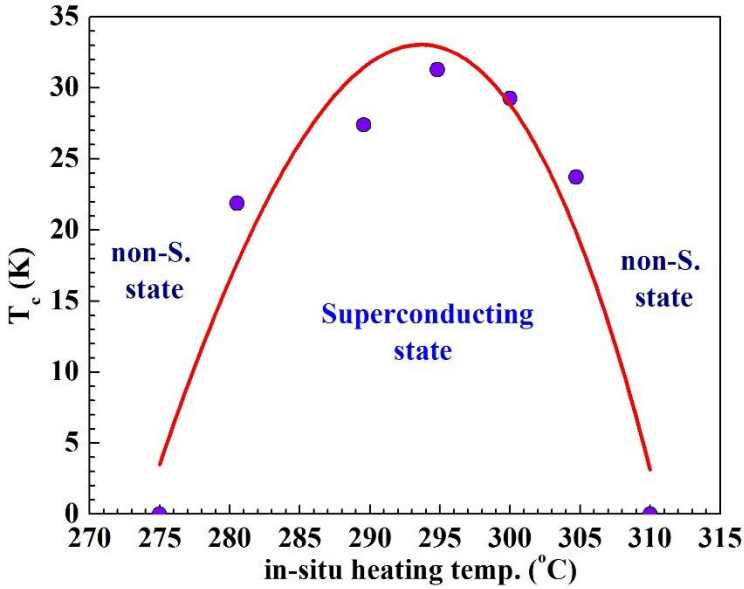

Figure 1. Transition temperature versus substrate temperature of fabricated films

PB020

Numerical simulation of the a-Si:H/µc-Si:H tandem solar cell performance sensitivity to the µc-Si:H tunnel junction dopant concentrations and thickness.

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Keywords: a-Si:H solar cell; µc-Si:H solar cell; a-Si:H/µc-Si:H tandem solar cell; Tunnel recombination junction; Silvaco-Atlas simulation.

We have performed a numerical study using Silvaco-Atlas simulator to model a-Si:H/µc-Si:H p-i-n type double-junction solar cell incorporating n-p type µc-Si:H tunnel recombination junction (TRJ) between the a-Si:H top and µc-Si:H bottom cells. This work deals with the effects of the donor and acceptor concentrations and thickness of the TRJ on the photovoltaic parameters (J_{sc}, V_{oc}, FF and η) of the tandem solar cell. We first simulated separately two a-Si:H and µc-Si:H subcells of the tandem solar cell and their conversion efficiencies are found to be, respectively, 9.24% and 6.9%, in agreement with experimentally determined efficiencies. For the tandem cell, the conversion efficiency is enhanced to 10.26%, in good agreement with an experimentally published efficiency. By increasing the donor concentration of the TRJ, we found that V_{oc}, FF and η are enhanced while the J_{sc} remains almost constant. On the other hand, FF and η are mainly affected by the acceptor concentration and thickness of the TRJ, contrarily to the J_{sc} and V_{oc}. With this simulation work, we explained the influence of variations of the TRJ parameters on the tandem cell performance in terms of the sensitivity of internal quantities, like the recombination rate and the band diagram to the TRJ parameters. To obtain the largest conversion efficiency of the tandem cell the recombination peak was found approximately located at the middle of the p-layer in the TRJ where the quasi-Fermi levels were close to each other.

PB021

Growth and Characterization of Gallium Doped Zinc Oxide Thin Films by RF Magnetron Sputtering for Solar Cell applications

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[keywords] TCO, Solar cells, Thin films,

ZnO has a direct band gap with 3.37 eV energy gap at room temperature with a large exciton binding energy of 60 meV. ZnO, having natural n-type conductivity with a large abundance in the Earth's crust, is easy to produce and process. Its use for TCO thin film coating material has gained a substantial interest. ZnO is a very important alternative to GaN, Si, and indium tin oxide (ITO) for use in solar cells, LED's, OLED's, and touchscreens [1]. Moreover, ZnO has better thermal and chemical stability than GaN whose electrical and optical properties are similar to those of ZnO. Its resistance to humidity and radiation makes ZnO superior for its space and harsh weather applications. Despite such successful research developments in the field of ZnO TCO materials, cheap, effective, and good quality ZnO TCO material production methods are needed to be developed for wide spread industrial applications of these materials [2,3]. Especially corrosion resistance of ZnO must be increased. Hydrogen passivation plays a major role for that purpose. In this work, we investigated the electrical and optical properties of high purity ZnO thin films doped with varying concentrations of gallium. Ga doped ZnO thin films were grown on glass substrates via RF magnetron sputtering. Then, hydrogen passivation was carried by treating the surfaces of ZnO thin films with varying concentrations of (NaOH)aq solutions at different temperatures with varying time intervals in order to enhance their electrical, optical, and structural properties. UV-VIS-NIR, FTIR, and Raman, spectroscopies were used for optical characterization, 4-point probe method was employed for electrical studies, and SEM, AFM, and XRD were used for structural characterization. Optimum values of growth parameters, such as Ga dopant amount, growth temperature, the temperature and duration of (NaOH)aq treatment, etc. were studied by systematically changing the growth parameters for repetitive growths. Our analysis provided a good set of growth parameters for the GZO thin films on glass substrates with desired optical, electrical and structural properties.

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PB022

Effect of Cu content on TiN-Cu nanocomposite thin films on hardness

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[keywords] thin films, ion plating

Titanium nitride (TiN) thin films and titanium nitride/copper (TiN/Cu) nanocomposite containing 2–7 at.% Cu films were deposited by ion plating technique at the assistance of hollow cathode gun (HCG) on 316 stainless steel substrates at 623K. The influence of Cu content and bias voltage on the microstructure, morphology and mechanical properties of deposited films were examined. Structural properties of the films were studied by X-ray diffraction (XRD) pattern. Topography of the deposited films at various applied bias voltages was investigated using atomic force microscopic (AFM). Thickness of the films was measured using Rutherford backscattering spectroscopy (RBS) technique. Film hardness was estimated using a triboscope nanoindentation system and X-ray photoelectron spectroscopy (XPS) analysis was performed to study the surface chemical bonding states. XRD and nanoindentation results showed that TiN film prepared at 30V bias has better crystalline structure with highest hardness of about 31GPa. In the case of (TiN/Cu) nanocomposite, the results showed that the film hardness decreases significantly from 11.7 to 2.8 GPa for Cu content from 2 to7 at.% respectively, due to copper particle segregation and its lubricant effect. XPS results showed that Cu and TiN phases grew separately and in our case, the formation of a solid solution or chemical bonding between Cu and Ti is rejected.

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PB023

SnO_2:F/p-Cu(In,Ga)Se_2/Al Schottky contacts analysis of photovoltaic chalcopyrite thin film absorbers

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keywords: Cu(In,Ga)Se_2, thin film, Schottky contact, SCAPS.

Cu(In,Ga)Se_2 (CIGS)thin films have been deposited on glass SnO_2:F by close space vapor transport technique (CSVT). Al Schottky contacts deposited on Cu(In,Ga)Se_2 thin film devices by physical vapor depodition (PVD). Current density–voltage (*J*-*V*) and capacitance–voltage (*C*-*V*) characteristics measurements was achieved and have been served to extract the electrical parameters of SnO_2:F/CIGS/Al Schottky diodes using the double exponential diodes model. Simulations using the SCAPS routine confirm our experimental results. Etching the CIGS surface by bromine/methanol mixture yields a nearly pure metal-semiconductor behavior, including effects resulting from an additional diode at the FTO back contact. TElectrical parameters such as the square serie resistance (R_s) is less than 2 Ω.cm^2 whereas the square shunt resistance (R_{sh}) is greater than 5 kΩ.cm^2 and the ideality factor *A* of the diode is around 2 indicating that the transport process is governed by the generation-recombination mechanism.

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PB024

Frequency response of interface states and series resistance in PolySi-oxide-cSi (MOS) and PolySi-cSi (MS) structures

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[Key words] C-V characteristic, frequency dependency, interface states, MOS and MS structures

The capacitance-voltage (C-V) and conductance-voltage (G/ω-V) characteristics of PolySi-oxide-Silicon (MOS) and PolySi-Silicon (MS) structures have been measured in the voltage range from -30 to +30 V and frequency range from 10 KHz to 1MHz. It is found that both the capacitance and conductance of the PolySi-oxide-Silicon (MOS) and PolySi-Silicon (MS) capacitors are very sensitive to frequency. The fairly large frequency dispersion C-V characteristic can be interpreted in terms particular distribution of interface states at Si/SiO_2 interface and the effect of series resistance. At relatively low frequencies, the interface states can follow an alternating current (AC) signal that contributes to excess capacitance.

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PB025

Effect of Annealing Temperature on Structural and Optical Properties of NiO Thin Films Deposited by Silar Method

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[keywords] SILAR, NiO, thin films, annealing.

Nickel Oxide (NiO) thin films have been deposited by Successive Ionic Layer Adsorption and Reaction (SILAR) method on glass substrates and subsequently annealed from 200 to 500 ^{0}C for 0.5 h.The influence of annealing temperature on the structural and optical properties was analyzed by X-ray diffraction (XRD), scanning electron microscopy (SEM), atomic force microscopy (AFM), Frourier Transform Infrared (FTIR), UV spectrofotometer respectively.

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PB026

Microstructure and wear behaviour of Ti doped Cr–N coatings

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[keywords] CrN, Coating, Properties, Wear

Hard Cr–N and Titanium doped Cr–Ti–N coatings were deposited using thermo-reactive deposition technique on the pre-nitrided AISI 4140 steel in the powder mixture consisting of ferrous chromium, ferrous titanium, ammonium chloride, and alumina. Coatings doped with various Ti contents were synthesized by changing ferrous titanium content in the powder mixture. Composition of the films was analyzed using energy dispersive X-ray spectroscopy (EDS). Microstructure and properties of the coatings were characterized using X-ray diffraction (XRD), scanning electron microscopy (SEM), and atomic force microscopy. The harnesses of Cr–Ti–N coatings gradually increased with rising of Ti content and exhibited a maximum at Fe-Ti content of 5 wt. %. The maximum hardness of the Cr–Ti–N coatings were approximately 27.5±0.8 GPa. Further increase in the Ti content resulted in an increase in the hardness of the coatings. Results from XRD analyses of CrN coatings indicated that the phases formed in the coating layers are CrN, Cr_2N and Ti_2N. SEM observations of the sections of Cr–Ti–N coatings with different Ti concentrations showed a typical smooth structure. AFM study showed that, increase in Ti content in the coating layer caused to increase of the surface roughness. Friction coefficient of titanium doped Cr–N coatings from ball-on-disk test were higher in comparison to that of CrN coatings, while wear rate was decreased.

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PB027

Ferromagnet/Superconductor Hybrid Thin-Films

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[Keywords] Ferromagnetic/Superconducting Hybrid Thin-Films

Several ferromagnet/superconductor bilayer hybrids were studied both theoretically and experimentally in recent years. As reported in [1-4], ferromagnet/superconductor hybrids show exclusive states due to the mutual interaction between the superconductor and the ferromagnetic substructures in micro-scale.

In this research study, the mutual interaction between ferromagnetism and superconductivity states has been investigated in a coupled ferromagnetic/superconducting thin-film structure (F/S hybrid). In a typical F/S hybrid structure, superconducting films were grown with underlying segments of thin magnetic stripes in perpendicular and parallel orientations to the current flow direction. Thermal & sputter combined physical vapor deposition techniques and various topographic micro-patterning processes were utilized. Low-temperature DC transport measurements were performed using standard 4-point probe method in a 9T closed-cycle dry-cryostat at various H-fields.

The results revealed that the artificial periodic modulation of magnetic field through underlying magnetic stripes, oriented along and across the superconducting films, introduce normal and superconducting channels or barriers for current flow resulting in change of superconducting properties (T_C and H_{C2}). This behaviour can guide us for designing and fabricating functional superconducting devices such as a low-power persistent current switch for novel superconducting applications.

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PB028

Blue Light Filtering Applications in Ophthalmic and Intraocular Lenses

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[keywords] Blue light filter, retinal damage, rhodopsin.

One of the photochemical damages suggested by animal studies is associated with short exposures operating at the level of the retinal pigment [1]. These short exposures, less than 12 hours, to relatively intense short-wavelength light can cause retinal damage that is also called as “blue light hazard” [2]. Retinal damage was observed only in the presence of the visual pigment, blue-light-induced retinal degeneration is rhodopsin mediated. In the eye, lipofuscin, also known as “the age pigment” accumulates over the years and builds up at a faster rate in some retinal diseases [3]. Photoreversal of bleaching which occurs only in blue but not in green light, increases the photon-catch capacity of the retina and may thus account for the difference in the damage potential between blue and green light [4]. In visible spectrum, wavelength between 380 and 500 nm include violet-blue, and green appearing wavelengths. The sun is the primary natural source of blue light, but cool white LEDs and fluorescent lambs are artificial blue light sources [5]. People are exposed to blue light derived from both sun and artificial light sources. Filtering of blue light has been proposed as a possible mechanism of protection [6]. So that in recent years, blue light filtering applications have been developed with ophthalmic, intraocular lenses. A number of investigators have proposed the use of yellow appearance of ophthalmic and intraocular lenses which attenuate short-wavelength light to reduce retinal damage [7, 8]. Blue light reduction can be attempted by tinting lenses in yellow which absorb blue light. Instead, new commercial coating materials adopted antireflection (AR) coating technology. Taking advantage of the principles of AR coating in the opposite way, these coating prevents blue light from passing through the lens by increasing the reflection of blue light. In conclusion, production of blue light filtering lenses and recent advances in blue light filters applied to ophthalmic and intraocular lenses are reviewed, and advantages/ disadvantages of these filters are discussed.

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PB029

Light Gathering Angle and Luminous Intensity Analyses on Power LED Reflector

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[keywords] LED, reflector, light-gathering angle, luminous intensity, parabola

LEDs are commonly used in indoor and outdoor during the recent years due to its advantages. When electrical, thermal and optical conditions of LEDs are provided, desired output can be taken from the LED lighting system [1]. For its electrical design, a proper actuator network must be designed for LED system. To fulfil the thermal conditions, proper cooler equipment must be provided for LED. High optical output can be provided with the proper reflector design for LED [2-3]. In our study, for the LED having high activity value, reflector surface designs having different light gathering angles are made. In the analyses made, light intensity distribution curves are obtained related to use of surface material and lighting surface features. It is aimed that this study will be a guide on examining the effect of reflector light-gathering angle on luminous intensity.

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PB030

Probing specific oxides as supports for metal/oxide model catalysts: MgO(111) polar film

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[keywords] Thin oxide films, metal/oxide model catalysts, surface science techniques.

Nanosized metal clusters and thin films supported on metal oxides are important from both the fundamental and applied viewpoints, such as nano- and optoelectronics, chemical sensors, composite ceramic materials, heterogeneous catalysis. It is considered, for instance, that the catalytic efficiency of such supported systems is mainly defined by the specific structural, morphological and electronic properties of metal particles, whereas the effect of the support is not significant. However, recent research shows that the nature, stoichiometry and atomic structure of the oxide support, as well as the metal/oxide perimeter interface play an important role in catalysis [1]. In this regard it would be interesting to test the properties of the oxide support with special properties, like polar surface of MgO(111) film. It has been shown previously that such film can be grown on Mo(110) substrate in ultra-high vacuum, either by thermal evaporation of bulk magnesium oxide, or by reactive oxidation of metallic magnesium film [2,3]. Ordering effect of the substrate due to close lattice constants of Mo(110) and MgO(111) determines formation of such polar film up to thickness of 2 nm. As a potential oxide support for metal/oxide supported catalysts it would be interesting to test its properties towards adsorption of gas molecules. For this purpose, comparative study of adsorption of carbon monoxide (CO) on structural ordered stoichiometric MgO(111) and MgO(100) films and on Pt(111) surface in ultra-high vacuum has been studied by means of X-ray and ultraviolet photoelectron spectroscopy (XPS, UPS), reflection-absorption infrared spectroscopy (RAIRS), low-energy electron diffraction (LEED) and work function measurements (Anderson method) using modified VG Escalab Mk II system. Adsorption of CO has been done by backfilling the chamber by CO up to partial pressure of 10^{-7} mbar at substrates cooled down to 80 K. Both UPS and RAIRS detected no CO signal for Mg(100) film, whereas quite noticeable signals were detected upon adsorption of CO on MgO(111) film. Comparison of the results for MgO(111) and Pt(111) shows that the adsorption mechanism of CO on Mg(111) is different from that occurring on Pt(111). In the former case the mechanism is determined by high local electric field at the surface, driving the molecules to specific electronic state different from that occurring on the metal substrate. This offers an opportunity of design of metal/oxide catalysts with new features determined by polar oxide support.

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PB031

Structural and optical properties of ZnO nanorods prepared by spray pyrolysis method

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[keywords] ZnO nanorods, spray pyrolysis deposition.

ZnO is one of the most important multifunctional materials with an exciton binding energy approaching 60 MeV and a direct band gap of 3.37 eV which produces an efficient excitonic emission rate. It is one of the few metal oxides which can be used in numerous technological applications such as light emitting diodes (LEDs), photoelec-tronic devices, laser diodes (LDs) and solar cells [1]. ZnO can be produced by several techniques such as laser ablation, sputtering, spray pyrolysis, sol-gel process and chemical vapour deposition [2, 3]. Compared to other deposition techniques, spray pyrolysis methods opportunities several advantages like non-vacuum use of inexpensive equipment, ease of large-scale adoption and possibility of automation for industrial use. Moreover, it can offer control of the basic characteristics of the as-grown samples through the deposition conditions, such as substrate temperature, type and concentration of precursor solution, type and pressure of the carrier gas, geometric characteristics of the spraying system and spraying rate [4]. The zinc oxide (ZnO) nanorods have grown on glass substrate by spray pyrolysis deposition (SPD) method. Using spray pyrolysis deposited ZnO nanorods as a nucleation platform were grown on the seed layer. The precursor seed layer solution was prepared by mixing 0.1 M of zinc acetate. The glass substrate temperature was 400 ^{0}C and the spray rate was controlled as 5 ml/min for all the deposition conditions. The growth of vertically aligned ZnO nanorods was carried out in the second stage of growth process. Using this stage equal mole of hexamethylenetetramine (HMT) and zinc nitrate has been used as precursors. Field emission scanning electron microscopy images show that ZnO films consist of nanorods morphologies. X-ray diffraction illustrate that ZnO films are polycrystalline with (002) plane as preferential orientation and also the optical transmittance spectrum shows that transmittance reaches to a maximum value of about 80% for the visible region ZnO films.

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PB032

Tight Binding Modelling of Composition and Interface Strain Effects in Nanoscale Epitaxial and Colloidal Heterostructures

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[keywords] Epitaxial and Colloidal nanoscale heterostructures, tight binding theory.

Advances in growing semiconductor thin films having differing physical properties with varying composition and layer thickness (even approaching atomic dimensions) have provided new opportunities and challenges in scientific studies and fabrication of novel electronic and optical devices for technological applications. We present a semi-empirical nearest neighbor (NN) sp^3s^* tight binding model to investigate the effect of alloy composition and interface strain on the electronic band structure of the constituents of nanoscale epitaxial and colloidal IV elemental and III-V compound alloy/binary heterostructures. The model is based on the spin-orbit coupling of p-states, nearest neighbor (NN) atomic interactions and intra-atomic Coulomb interactions between s-s, s-p and p-p states of cation and anion atoms forming binary semiconductor. Interaction matrix elements are then found from the fitting of the calculated results to the real band structure of semiconductors at high symmetry points. Nonlinear expressions are derived for the atomic energy levels and bond lengths as function of alloy composition and interface strain in nanoscale epitaxial and colloidal heterostructures. Results of the calculations are discussed for the AlGaN/GAN, InGaN/GaN, GaAsN/GaAs, $Si_{1-y}C_y$/AlN and $Si_{1-y}C_y$/GaN, $Si_{1-x}Ge_x$/Si(001), $Si_{1-x}C_x$ /Si(001) and $Si_{1-x-y}Ge_xC_y$ /Si(001) binary alloy/elemental semiconductor nanoscale heterostructures as a function of interface strain and alloy composition. The interface strain effects on the conduction band offsets in the $Si_{1-x}Ge_x$/Si(001) (and $Si_{1-y}C_y$ /Si(001) heterostructures are found to be quite large since the lattice mismatch increases with increase in the alloy composition, especially since the conduction band deformation potential is large. The proposed model shows good agreement with available experimental data for band offsets and has a considerable potential in the design and optimization of group IV elemental and III-V compound alloy/binary semiconductor nanoscale heterostructures for electronic and optical devices.

PB033

Effects of Interface Strain and Growth Temperature on Optical and Dielectric Properties of CdSe and CdSe/ZnS Nanocrystals

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The synthesis of semiconductor nanostructures have been advanced rapidly over the last two decades as variety of interesting electronic and optical properties and possible applications result from the confinement of carriers in three dimensions. For example, CdSe/ZnS and CdSe/CdS core/shell quantum dots can be used different applications because of their strong size and shape dependent properties such as biomedical imaging, display devices, photovoltaics and lasers. Realization of the full potentials of nanoscale heterostructures for the electronic and optoelectronic device technologies require economically feasible production and characterization techniques and qualitatively reliable and quantitatively precise predictive physical modelling of electronic, optical and dielectric properties of semiconductors. In this work we will present our recent work on the synthesis, characterization and modelling of CdSe/ZnS core/shell quantum dots. The CdSe bare core and CdSe/ZnS core/shell nanocrystals were synthesized by using colloidal technique at varying temperatures from 130^0C to 170^0C. The x-ray diffraction (XRD) and transmission electron microscopy (TEM) techniques were used to characterize the interface strain and the size of nanoparticles and the number of atoms involved during the formation of CdSe/ZnS core/shell nanoparticles, respectively. Size of CdSe nanoparticles and their electronic properties are also determined by using the effective mass approximation. Optical absorption, flourecsence and dielectric spectroscopy techniques were used to characterize the optical properties and dielectric constant of CdSe and CdSe/ZnS nanoparticles. TEM results indicate that the bare CdSe and CdSe/ZnS quantum dots are well-ordered crystallized with average particle sizes 4.3±0.02 nm, which accords well with UV-Vis NIR spectrum results. Optical absorption peaks show that 1st excited state energy is temperature dependent. Increase of temperature during synthesis leads to a linear increase in nanoparticle size and linear decrease in band gap energy, respectively. Dielectric measurements carried out on samples prepared at different temperatures, show that there is a linear increase in optical dielectric constant (ε') with increase in nanoparticle size, approaching the bulk value for larger particles. The dielectric constant of CdSe nanocrystal in the frequency range 20 Hz-10 MHz shows that the dielectric constant of all the samples is high at lower frequencies, which decrease with increasing frequency for all temperatures of measurement. The dielectric loss tangent ($\tan\delta$) decreases with frequency and the sample with minimum particle size shows large value of loss tangent at a specific frequency. The a.c. electrical conductivity (σ_{ac}) is found high for higher frequencies at a given temperature for all samples. All the three quantities, dielectric constant, loss tangent and AC conductivity depend on particle size, frequency and temperature.

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PB034

Synthesis and Characterization of Tm-doped ZnO Nanorods

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[keywords] One-Dimensional Thin Films, Transparent Conductive Oxides, ZnO nanorods.

In photovoltaic (PV) solar devices, a transparent conducting oxide (TCO) film is used as a transparent electrode which permits sun rays to reach to the photoactive semiconducting layers and also to collect the photogenerated electrons. Indium tin oxide (ITO) is the most commonly used TCO material for PV applications. Alternative materials are also being investigated and developed because indium is a toxic material with limited supply. Due to their tailorable electrical and optical properties zinc oxide (ZnO) based thin films and nanostructures are considered as an abundant and safer option for TCOs. However, the electrical and optical properties of undoped ZnO is not highly stable due to incorporation of atmospheric oxygen [1]. Thus, doping of ZnO is widely studied using different elements and fabrication methods in order to improve conductivity and stability. [2]. Also, recently, due to their unique properties related to the geometrical shape 1D nanostructures (nanowire, nanorod and nanotube) are investigated for applications in many fields [3]. In this regards, we synthesized Thulium (Tm)-doped 1D ZnO nanorods. The growth of undoped and Tm-doped 1D ZnO nanorods on microscope slide substrate will be pursued via sol-gel spin coating and hydrothermal methods. The fabricated Tm-doped 1D ZnO nanorods characterized using x-ray diffraction (XRD), scanning electron microscopy (SEM), four point probe method and UV-VIS spectrophotometry. The solubility limit of Tm^{3+} ions in ZnO lattice was found to be 4 mol % from XRD data. In the stoichiometric range of 1 and 4 mol %, all the thin films have vertically aligned nanorod structures.

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PB035

Synthesis, Characterization and Modelling of CdSe/Cd_x $Zn_{1-x}S$ ($0 \leq x \leq 1$) Core/Ternary Shell Nanocrystals

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[keywords] Nanocrystals, CdSe/CdZnS core/shell quantum dots.

Semiconductor nanocrystals (known as quantum dots (QDs)) have been the subject of great scientific and technological interest due to their potential optical applications that include photovoltaics, solar cells, light emitting diodes (LEDs) and lasers. CdSe based quantum dots can be a good candidate to use as an intermediate bandgap layer in solar cells. QD solar cells have the potential to increase efficiency of solar photon conversion by generating and collecting additional electron–hole pairs.

In this work, we used chemical synthesis technique to prepare the CdSe based CdSe/Cd_x $Zn_{1-x}S$ ($0 \leq x \leq 1$) core/ternary shell nanocryctals. The synthesized nanocrystals were characterized using the x-ray diffraction (XRD) and TEM for structural properties along with UV absorption, fluorescence and dielectric for optical properties. Compressive force applied on CdSe (core) by $Cd_xZn_{1-x}S$ shell led in band gap increase and core size decrease relevant with alloy composition and strain amount. The lattice mismatch induced interface strain between core and shell obtained from continuum elastic theory (CET) and applied in effective mass approximation (EMA) to calculate corresponding capped core diameter. The results compared with bare CdSe size from TEM to evaluate squeeze amount in core size after compressive shell deposition. İnduced interfacial strain amount found to be proportional with Zn-S bonds in alloy composition which induce higher compressive strain in core region. The relaxation peaks in dissipation factor (tan δ) found to shift to higher frequencies as composition of Zn-S bond increases in shell material.

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PB036

Synthesis, Characterization and Modelling of ZnSe/Zn(Cd)S Core/Shell and ZnSe/Zn(Cd)S /Cd(Zn)S Core/Shell/Shell Nanocrystals

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[keywords] Nanocrystals, ZnSe/Zn(Cd)S and ZnSe/Zn(Cd)SCd(Zn)S core/shell quantum dots.

Colloidal semiconductor quantum dots (QDs) have the advantages of high stability, solution processability, tunable emission wavelength and high color saturation. In the broad application of QDs, light-emitting diodes (LEDs) based on colloidal QDs have attracted considerable interest in the past few years for use in flat panel displays and solid state lighting. ZnSe based quantum dots (QD) are semiconductor nanocrystals that possess unique optical properties and they are the potential candidate for next generation LEDs and photovoltaic devices. Their emission color can be tuned from the visible throughout the infrared spectrum.

In this work we report a synthetic route to prepare type-I and type-II core/shell ZnSe/Zn(Cd)S and core/shell/shell ZnSe/Zn(Cd)S/Cd(Zn)S colloidal spherical quantum dots. The synthesized nanocrystals were characterized by using high resolution TEM and x-ray diffraction (XRD) for structural properties and UV absorption and fluorescence techniques for optical properties. The effects of lattice mismatch induced interface strain on the first exciton energy, capped core diameter and conduction and valence band energies of the quantum dots investigated. The induced interface strain from lattice mismatch between core and shell(multishell) calculated from continuum elastic theory and applied in effective mass aproximation (EMA) to calculate corresponding capped core diameter. The results compared with bare core images from TEM to evaluate squeeze (stretch) amount in core size after compressive (tensile) shell deposition.

PB037

Improved Raman Scattering from Flower-like Silver Nanostructures on Porous Silicon

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[keywords] Porous Silicon, silver dendritic nanostructure, Raman scattering.

Silver dendritic nanostructures have been prepared on n-type porous Si substrates (PSi) at different current densities and deposition times by electrodeposition technique from an aqueous solution of $AgNO_3$. Effect of deposition time, current density and concentration of Ag solution on the structural properties of PSi/Ag nanoparticles have been characterized by using scanning electron microscopy (SEM), energy dispersive X-ray analysis, X-ray diffraction (XRD) and Raman spectroscopy. SEM analysis has revealed that a rough silver film containing randomly spaced dendritic structures or nanoparticles were formed during electrodeposition, depending on the deposition time, current density and concentration. A diffusion-limited aggregation model has been used to explain the growth of Ag dendrites by taking into consideration of deposition parameters [1]. Raman results of PSi/Ag nanostructures have indicated that the shape of the Ag nanostructures significantly affects the Raman signal of PSi/Ag nanostructures. The Raman analyses have also shown that the Raman signal of spherical Ag nanoparticles on PSi is too weak (factor of $10\text{-}10^2$), whereas the Ag dendrites on PSi provide a higher Raman signal enhancement factor of 10^4. The difference in the Raman spectra of the Ag nanostructures can be explained by electromagnetic (EM) enhancement mechanism [2]. According to our Raman analysis, the PSi/Ag nanostructures can be used as SERS-active substrates in many fields, such as chemical and biosensing applications [3].

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PB038

Design of solar cells p^+/n emitter by spin-on technique

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[keywords] Bore, spin-on, solar cells emitter

In the photovoltaic solar cells fabrication, more than 90% were made with p-type silicon substrates. However, this substrate type suffers from light induced degradation effect and is more sensitive to metallic impurities contamination which limits the efficiency. On the contrary, n-type solar cells offer a way of avoiding the efficiency penalty associated with these disadvantages [1,2].For this reason an increasing use of this type of silicon is predicted for the coming years [3]. Several n-type solar cells structures exist which use a variety of processing techniques among which the spin-on technique that is used for performing the p^+/n emitter.

In this paper spin-on dopant diffusion has been investigated as a technique for fabricating front p-type junction in silicon solar cells.

The experiments consist of a boron compound liquid layer which is spin-coated on a NaOH etched n-type monocrystalline 4 inch silicon wafer surface to provide a homogenous doping layer. After baking step, the doped wafers were transferred to quartz tube furnace for high temperature drive-in process. The liquid dopant source is a B155 from *Filmtronics Inc*. [4].

A preliminary works has been conducted in order to obtain a homogeneous spreading of the solution leading to a uniform surface coating. We found that a volume of 2 ml per wafer is necessary to wet the entire front wafer surface and three steps spinning profile corresponding to a total time of 50 seconds. This was followed by the study of the effect on emitter characteristics of wafers stacking arrangements into the quartz diffusion boat during the drive-in. We found that the wafers arrangement has a great impact on front and back resulting sheet resistances and their homogeneities. The highest doping level and the best uniformity of the emitter were obtained using the back-to-back wafers arrangement. This configuration was adopted to design a bore p^+ emitter suitable for n-type solar cells.

Study of the ratio N_2/O_2 of process gases showed that a higher percentage of nitrogen yields a slightly lower emitter sheet resistance. A ratio of 2/1 has been adopted.

Due to bore atoms activation, the mean sheet resistance before BRL and BSG etching decreased from 47.5 Ω/□ to 28.5 Ω/□ with temperature increase from 910°C to 950°C. We observed that the sheet resistance uniformity improved with temperature increase. We also found that the impact of the process time duration on resulting emitter sheet resistance depends on the process temperature. At high temperature of 950°C, the process time duration has a weak impact, on the contrary of the lower temperature of 910°C.

To realize an n-type solar cells emitter, a temperature of 910 °C and process time duration of 20 minutes was adopted. The post-diffusion mean sheet resistance of 48 Ω/□ was obtained. After the HNO_3 etching of the BRL, the mean sheet resistance was increased to a mean value of 52 Ω/□. The boron depth profiling by means of ECV technique revealed a surface concentration of around 1E20 atoms/cm^3 and a junction depth of 0.3 µm.

Using a spin-on technique and a boron liquid dopant source, we realized a p^+ emitter suitable for n-type solar cells. However, the used dopant source is not well suited for an improved emitter (lower surface concentration and deeper junction depth).

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PB039

Comparison between Screen Printed Phosphorus Diffusion Pastes on Multi-Crystalline Silicon Solar Cells

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[Keywords] Screen printing, diffusion paste, annealing temperature, Hall effect, SIMS.

This paper focuses on creation of P-N junction, using two commercially screen-printable phosphorus diffusion pastes for Multi-Crystalline Silicon Solar Cells realization [1]. Comparison between Hall Effect and SIMS measurements of profiles and junction depth as a function of annealing temperature is reported [2]. Surface concentration (Ns) by Hall Effect from 2.95 10^{20} to 3.68 10^{20} (at/cm^3) and 09.66 10^{20} to 4.67 10^{21} (at/cm^3) by SIMS according to process settings are obtained for paste 1 and 2 respectively. For the range of annealing conditions investigated, the increase of the temperature leads to deeper emitters. Anymore, paste 2 shows surface concentration and junction depth (x_j) higher than paste 1 due to the paste composition. The 2 pastes enabled homogenous emitter. This means that the p-doping pastes are effective for forming emitters, but a good knowledge of their formulation will lead to optimize the results [3].

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PB040

A comparative Tight binding and DFT study of Structural and electronic properties of wurtzite and zincblende $Al_{1-x}In_xN$

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[keywords] Density Functional Theory, sp^3s^*tight bidning theory, AlGaN/GaN heterostructures

The semiconductor alloy $Al_{1-x}In_xN$ has a band gap that covers a very wide energy range (0.69 eV to 6.25 eV) [1] which makes $Al_{1-x}In_xN$ an ideal candidate for a range of electronic and optoelectronic devices such as high electron mobility transistors (HEMTs) for high-frequency and high-power microwave applications [2] and also for the application in highly-reflecting distributed Bragg reflectors (DBRs), light-emitting diodes (LEDs), laser diodes (LDs), detectors and sensors [3]. Both AlN and InN crystallize in wurtzite structure, however stabilization in zincblende structure of these compounds by molecular beam epitaxy has also been achieved [4], subsequently the ternary alloy AlInN can occur in both forms. We present a detailed theoretical study of the structural and electronic properties of these two phases, carried by first principles using DFT and by semi-empirical tight binding method (TB). In order to improve band gap drawbacks we will be using the potential introduced by Tran Blaha [5] which gives a good correction to the gap, and the optimized values calculated from DFT will be associated with the tight binding calculation for ternary compounds. We investigated the alloy composition variation of physical entities such as the energy band gap, the electron effective mass, the density of states and charge density and will compare with available experimental/first principle data. The structural part of the study showed a good agreement between calculated values and experimental works. Concerning the electronic properties using mBJLDA yielded better gap results than other DFT works while using an sps*TB basis gives satisfactory results for the gap and effective mass and more accurate gaps than mBJLDA. While for effective masses there seems no noticeable differences between the zincblende and wurtzite phases the results of the gap on the other hand are quite different. From being direct throughout the entire range and with values ranging from 6.2 to 0.79 eV for the wurtzite to being indirect at first then direct and with a smaller span ranging from 5.4 to 0.63 eV for the zincblende.

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PB041

Electrochemical characterization of electrodialysis heterogeneous ion exchange membrane modified by clay nanoparticles

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[Keywords] Clay nanoparticles; Desalination/water treatment; Fabrication/electrochemical characterization; Ion exchange membrane; Mixed matrix.

Mixed matrix PVC/clay nanoparticles heterogeneous cation exchange membranes were prepared by solution casting technique. The effect of clay NPs concentration in the casting solution on membrane electrochemical properties was studied. Scanning optical microscopy images showed uniform particles distribution and uniform surfaces for the prepared ion exchange membranes. The membrane water content was enhanced initially by increase of clay nanoparticles content ratio up to 1%wt in casting solution and then it began to decrease by more nanoparticles concentration. Moreover, swelling was measured less than 5% in thickness and negligible in length and width for the prepared membranes. Membrane potential, transport number and perm-selectivity were improved by increase of clay nanoparticles loading ratio. Utilizing Cloisite nanoparticles up to 1%wt in the casting solution also led to an increase in permeability and flux for prepared membranes. The ionic permeability and flux were decreased again by a further increase in additive concentration from 1 to 4%wt. Also, membranes exhibited lower permeability and flux for bivalent ions in comparison with monovalent type. The membrane electrical conductivity and mechanical strength was enhanced by increase of clay nanoparticles concentration in membrane matrix. The modified membrane containing 1%wt clay nanoparticles showed more suitable electrochemical properties compared to others. The results are valuable for the electro-membrane process specially electrodialysis in water desalination and treatment.

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PB042

Electrochemical Properties of Novel Sandwich-type Phthalocyanines

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[keywords] Phthalocyanine, Lutetium, sandwich-tpype, electrochemical properties.

Over the two past decades, a substantial number of sandwich type metal complexes with phthalocyaninato ligands have been synthesized. These complexes display unique physical, spectroscopic and electrochemical properties since the large conjugated p systems in these complexes are held in close proximity by metal ions. In our previous study, we achived for the first time the synthesis of a new type of unsymmetrical and dimeric dilutetium tetraphthalocyanine, Lu(Pc)4, involving two double-deckers [2-4]. The electrical conductivity of this compound displays as inorganic semiconductor [5].

In this study, starting with 4-nitrophthalonitrile and 3-hydroxy-6-methyl-2-nitro-pyridin, 4-(6-methyl-2-nitropyridin-3-yloxy) phthalonitrile **3** was synthesized in dimethyl formamide at 60°C for 36 h. In the second step, metal-free phthalocyanine **4** was obtained by the reaction of compund **3** with metal Li in 10 dry amyl alcohol. To synthesis of lutetium bis-phthalocyanine (Pc_2Lu) 5, a mixture of compound 3, $Lu(OAc)_3.xH_2O$ and DBU was refluxed in 10 ml dry amyl alcohol for 6 h. All compounds purified by column chromatography (silica gel) with $CHCl_3$.

The novel compounds were characterized by elemental analyses, UV/vis, ^{1}H-NMR, MALDI-MS spectroscopy and IR spectroscopy.

The redox properties of the newly synthesized compound **5** were identified by voltammetry, *in-situ* spectroelectrochemistry in a non-aqueous medium. In addition, the electrochromic features of the complex has been examined in their cast films on indium- tin oxide (ITO) glass with voltammetry and electrocolorimetry supported spectroelectrochemistry, with the aim of determining technological applicability in electrochromic devices.

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PB043

Produced to transition metal doped, Dy: ZnO and Dy: MgO thin fims by Chemical Spray Pyrolysis method and investigation to the thin films structures

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[keywords] Diluted magnetic semiconductors (DMSs), Dysprosium, MgO and ZnO

In the last few decades, intensive research efforts have been devoted to investigate the properties of diluted magnetic semiconductors (DMSs), which combine the advantages of ferromagnetic materials and semiconductors at room temperature [1]. Owing to the exciton spin polarization and manipulation of charge, DMSs give rise to potential applications in spintronics, such as magneto-electronic and magneto-transport devices [2]. As is known, adsorption and doping of transition metal atoms are usually efficient approaches to modulate the electronic and magnetic properties of materials, which are widely used to produce DMSs [3]. The adsorptions of transition metal on very thin film and nanotube have been studied, and the results indicated that the electronic and magnetic properties are modified due to the impurities states [4]. Also doped semiconductors show different magnetic behaviors, depending upon the type of magnetic ions, concentration of them, synthesis route and experimental conditions [5]. In this paper, we have experimentally investigated optic and structural properties Dy: ZnO and Dy: MgO thin fims. Thus Dy doped ZnO and MgO polycrystalline DMSs thin films have been prepared on glass substrates by the Chemical Spray Pyrolysis method at 450°C substrate temperature. Optical and Structural characterization of produced Dy: ZnO and Dy: MgO thin films was investigated spectral absorption and transmittance measurements by UV-Vis double beam spectrophotometer technique and XRD, SEM, EDX, AFM techniques respectively.

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PB044

Chemical Deposition of Nanocrystalline Cu Doped ZnS Thin Films and Optical Pproperties

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Keywords: Thin films; Cu doped ZnS; Chemical deposition; Optical properties

It is important to note that the application of the pure ZnS nanocrystals is only limited to the ultraviolet region of light spectrum [1]. An effective method to improve the optical properties of ZnS nanostructures involves impurity doping. Since, the incorporation of transition metals (d^n) ions into the ZnS host crystals can influence their optical, magnetic and electrical properties [2-6]. As a result, because of incorporation of Cu^{2+} ions into the ZnS host matrix, the fluorescence emission is extended to the visible region. Hence, the Cu^{2+} ions serve as optical centers in the ZnS host matrix and enhance optical activity of the ZnS thin films [7]. In the present study, the nanocrystalline Cu doped ZnS (ZnS:Cu) thin films were successfully deposited using facile chemical deposition method in a weak acidic solution with pH of 6.0 at 80 °C. The films were characterized by energy-dispersive X-ray spectrometer (EDX), X-ray diffraction (XRD), scanning electron microscopy (SEM), ultraviolet-visible photometry, and photoluminescence spectroscopy. UV-Vis transmission data showed that the films were transparent in the visible region. The XRD pattern reveal that the ZnS:Cu thin films exhibited pure cubic crystal structure and the films consisted of small ZnS:Cu nanocrystallites, less than 10 nm in size, that showing quantum size effects. FE-SEM revealed a homogeneous morphology and dense nanostructures. The PL spectra of the ZnS:Cu films showed two characteristic bands, one intense band located at 380 nm and another peak at 500 nm. Furthermore, concentration quenching effect on the photoluminescence intensity has been observed.

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PB045

Characterization ultra-fine particulates by Scanning Electronic Microscopy , X-ray diffraction and Raman Microscopy in the Workplace

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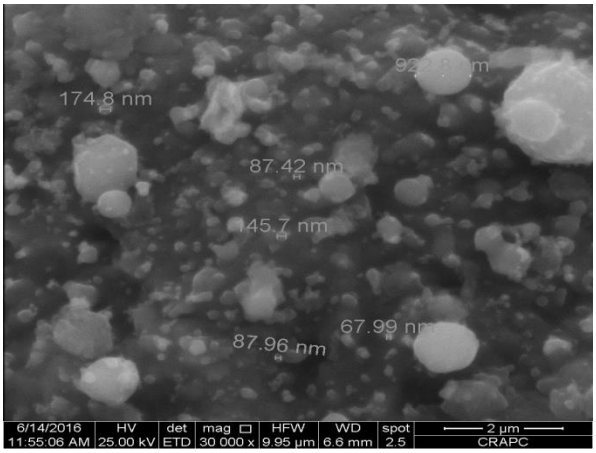
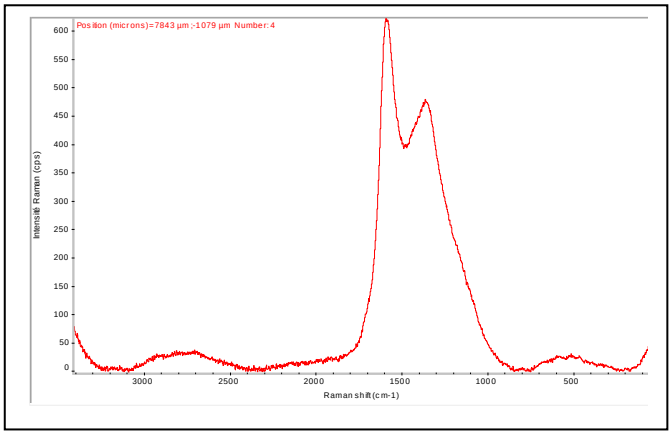
The last few years a growing interest in the development of applications implementing ultrafine powders as intermediate or finished products in industries as diverse as chemical, pharmaceutical , cosmetic , food , materials, industry , etc.

Human exposure to ultrafine particles (PUF <100 nm) and nanoparticle has become in recent years an important public health issue. These, in urban areas, can be formed by over 80% fines soot (<1 .mu.m) and ultrafine from combustion of fuels. These particles, emitted particularly by diesel vehicles in the short term gasoline vehicles and district heating, were quickly suspected cause of morbidity and mortality cardiorespiratory observed in epidemiological studies on the effects of the atmospheric pollution. They are mainly responsible for inflammatory responses can aggravate pulmonary diseases such as asthma and chronic obstructive pulmonary disease .

Our work's focuses on characterization of NPs and PUF by Scanning Electronic Microscopy and X-ray diffraction and Raman Microscopy, airborne nanosized particles and their importance to public health in the Workplace.



SEM microscopy



RAMAN spectrum

PB046

Fine silver powders for photovoltaic cells

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[keywords] Silver powder, Conductive paste, Solar cell, Structural properties

The preparation of fine silver particles is getting great attention due to the variety of application in electrical field such us conductive paste for solar cells metallization [1, 2]. The study, reports the preparation of silver powders by chemical reduction method because it gives fine silver powder controlled in shape and size [3] using silver nitrate as a starting material, Di Ethylen Glycol mono Ethyl Ether derivative as reducing agents.

From the XRD pattern, the diffractogram of powders exhibits the characteristic peaks of crystalline metallic silver. The morphological properties of the powders were analyzed using Scanning Electronic Microscopy (SEM/EDAX) and the mean particle size was estimated from image analysis of a laser distribution analyzer.

By addition of the Poly-N-VinylPyrrolidone (PVP) in the same reaction, two other powders were prepared. It was shown that the particle size and shape of the powder depend on the nature of protective agent [4, 5]. It is demonstrated here that the PVP plays a decisive role in preventing particle agglomeration and controlling silver particle size.

Conductive pastes were prepared for the front-side metallization of multi-crystalline cells using the obtained silver powders.

Silver layers with a uniform thickness are formed with the screen-printed pastes.

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PB047

Tribological Improvement of Stellite® using diamond like carbon coatings

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[keywords] DLC, tribology, diamond-like, Stellite, COF, wear

Stellite alloys are based on cobalt and chromium and are used in applications where wear resistance is needed, such as: hardfacing, valve seats, engines parts, and others. Nevertheless, despite the low values of coefficient of friction and wear rate, tribological performance of stellite can be improved using diamond-like carbon (DLC) coatings. In this work, DLC and DLC-Si coatings were prepared using 13.56 MHz capacitively coupled RF glow discharge using methane and silane as precursor gas and silane to produce an adhesion layer. Wear tests were carried out in a linearly reciprocating ball-on-flat testing geometry using a stainless steel 440C ball as counter body. Stroke length was 10 mm and oscillating frequency was 1 Hz. Applied normal loads produced average Hertzian stresses ranging from 200 MPa to 600 MPa. DLC coating was able to reduce satellite COF from 0.8 to values around 0.14. Even after testing for 2 hours no coating spallation was observed. Adhesion on satellite, evaluated by scratch test, was satisfactory. Critical load around 35 N was measured. Silicon doping (26.4 at%) ensured COF values lower than 0.1 at 110º C.

PB048

Quasi-steady state plasma distribution produced by a moving electron beam with constant velocity for coating

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[keywords] plasma, coating, electron beam.

This paper investigates the quasi-steady state plasma distribution produced by a moving electron beam with constant velocity. A moving electron beam with constant velocity is used to generate plasma, which can be applicable for coating or surface improvement of materials. Assuming the EB-generated plasma to be only a function of radial direction, the quasi-steady-state equations of continuity and momentum combined with Posson's equation were utilized to analyze the plasma distribution along the radial direction in a vacuum chamber. The results show that the effects of the electron-beam moving velocity and parameters at the radius of the electron beam on the plasma distribution are presented and discussed.

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PB049

The effects of carrier gas on 3D-2D transition of GaN

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[keywords] GaN, 3D-2D transition, carrier gas.

Gallium Nitride (GaN) and related materials (Ga-InAl/N) have been widely used in optoelectronic and electronic devices due to their excellent physical and optical properties [1-2]. Due to absence (or extremely high price of GaN substrate) of native substrates the growth of GaN has been established on foreign substrate such as sapphire, Si, SiC. The most preferable substrate is sapphire because of its price and large scale availability. The using of hetero-substrate bring serious of problems as a result of large lattice mismatch (%16) and thermal expansion coefficient difference [3]. The necessity of growth on sapphire brought new ideas about growth technology. We will present the effects of total volume of carrier gas, which is hydrogen in our case, on 3D-2D transition of GaN epitaxial layer. Because 3D-2D transition time effects the crystal quality, optical properties and surface topology of GaN layer seriously. Also new growth techniques of GaN material will be discussed.

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PB050

Carbon Nanotube Modification by Rotating Bed Plasma Chemical Vapor Deposition

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[keywords] PECVD, CNT, Surface modification.

Carbon nanotubes (CNTs) were discovered in 1991 by Sumio Iijima [1]. CNTs are derived from rolled graphene sheets consisting solely of carbon atoms. Modified CNTs can be used more usage areas when compared to non-modified CNTs. Various coating techniques are used to encapsulate the CNTs. However, it is very difficult to coat particles uniformly without agglomeration with liquid-based methods, especially for particle sizes below 100 [2]. Moreover, liquid-based techniques cause solvent related damages during the surface modification stages. On the other hand, plasma enhanced chemical vapor deposition (PECVD) is a dry process that is able to provide uniform solid coatings around particles under a gaseous environment [3]. Using rotating bed for PECVD system allowed sufficient mixing of CNTs during the depositions, hence the entire surface of the each CNTs are exposed to the reactant gases. Poly(hexafluorobutyl acrylate) (PHFBA) was used as the encapsulating polymer, and the encapsulation reactions were achieved by generating a plasma inside the reactor using a 13.56 MHz radio frequency (RF) source. The effects of plasma power, reactor pressure and monomer flow rate on the deposition rate and chemical structures of the coatings around the CNTs were investigated. FTIR and XPS analyses confirmed that very high retention of functional groups. The conformal coatings around individual CNTs were identified by SEM and TEM analyses. Water contact angle measurement techniques were carried out to determine the wettability of as-deposited PHFBA CNT surfaces. Modified hydrophobic CNTs were successfully obtained in this study.

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PB051

Investigating structural and mechanical properties of TiVZrN graded composite coatings

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[keywords] TiVZrN, Nanohardness, graded composite

In this study, TiVZrN graded composite coatings were deposited on the surface of AISI H13 steel substrate using pulsed DC closed field unbalanced magnetron sputtering method. Structural analysis were performed with Xry diffraction method. The hardness and elastic modules were evaluated with nano indenter method. The adhesion strength of coatings were characterized with scratch resistance tester. Results showed that increasing bias voltage increased the hardness and elastic modules of coatings. Increasing working pressure decreased the thickness of coatings.

PB052

Effect of Temperature on Poly Crystalline Zinc Oxide Thin Film Transistors

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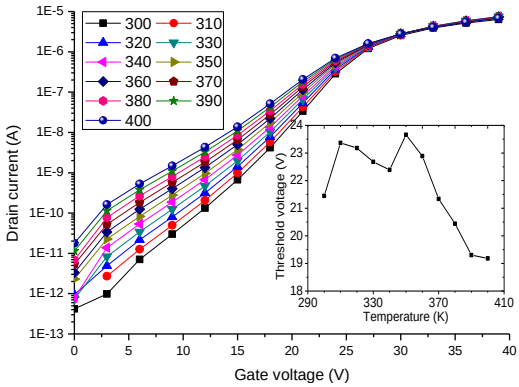
[keywords] Polycrystalline ZnO, TFT, Threshold Voltage, Temperature.

Thin film transistors (TFTs) play an important role in today's display panels due to unique characteristics of oxide semiconductors such zinc oxide (ZnO) [1,2]. In this work, we study the effect of temperature on the electrical characteristics of a thin film transistor based on polycrystalline zinc oxide (ZnO TFT). The study is carried using numerical simulation by SILVACO Atlas. The temperature was scanned from 300 to 400K. The transfer characteristics, the drain current versus gate voltage, of the ZnO TFT were first computed. The threshold voltage of ZnO-TFT is then extracted from these transfer characteristics. Furthermore, the drain current shows an Arrhenius-type dependence with temperature in the subthreshold regime with activation energy while it is inactivated beyond threshold voltage. The temperature dependence of the TFT characteristics was successfully compared to measurements [3].



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PB053

Metallization of Carbon Fiber-Reinforced Composite Materials with Magnetron Sputtering

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[keywords] CFRP, Metallization, DC magnetron sputtering

Carbon fiber-reinforced polymer (CFRP) materials are used to make aircraft and spacecraft parts, racing car bodies, golf club shafts, bicycle frames, fishing rods, automobile springs, sailboat masts, and many other components where light weight and high strength are needed [1]. These composites have favorable mechanical properties and low density in comparison to metallic materials, it is a poor conductive material. Protective and conductive coatings produced by physical vapor deposition (PVD) can increase the lifetime and surface conductivity of CFRP components [2]. In this work, copper thin films with various thicknesses (e.g. 70 to 1100 nm) were grown by DC magnetron sputtering techniques and the electrical and structural properties of coated copper thin films were explored. Furthermore mechanical behaviors such as adhesion to SCFRP surface were studied. The deposition was done in a chamber pumped with turbo molecular pump down to 6.0×10^{-6} Torr. Electrical characteristics of the deposited films are defined by four point method and thickness was determined with a help of profilometer. Structural properties of the CRFPs were investigated by SEM analysis. Adhesion testing was performed which is thermal shock testing by dipping in liquid Nitrojen (b.p -196 C) and boiling water (b.p +100 C). The Scoth tape with high adherence must not show any metal pieces [3]. Metallization of CRFPs was performed successfully due to the fact that the Scoth tape with high adherence was not showing any metal pieces. Our experimental results showed that the copper films were uniformly coated and carbon fiber-copper film adhesions were successfully verified.

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PB054

Optical Characterizations of Chemical Bath Deposited CdS Buffer Layers for Solar Cell Applications

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[keywords] CdS, Chemical Bath Deposition, XPS, XRD.

The CdS is one of the most promising material because of its n-type semiconductor characteristic and high band gap energy (in the bulk form E_g=2.42 eV) for heterojunction thin film solar cells [1]. Bulk form of CdS has refractive index of 2.52 at 600 nm wavelength which also makes this material suitable for solar cell application [2]. For CdS buffer layer, it is required to satisfy high light transmission through the absorber layer and to cover the absorber layer uniformly in order to avoid shunts between the absorber and front electrode. Therefore the growth technique is highly important point. There are many techniques for the deposition of CdS films: sputtering, thermal evaporation, chemical bath deposition (CBD), spray pyrolysis and molecular beam epitaxy. In each of these methods, CBD is widely used technique to obtain uniform, adherent, transparent and stoichiometric CdS thin films [3]. The aim of this work is to deposit CdS thin films by means of CBD technique and to investigate their optical and structural properties depending on the bath temperatures and bath preparation order. The optical characteristics of CdS films are obtained using UV-VIS Spectrophotometer and Spectroscopic Ellipsometer (SE) while the atomic concentrations of them are determined using EDX and X-ray Photoelectron Spectroscopy (XPS). The results revealed that the grown CdS films are stoichiometric and their optical constants are highly favorable for photovoltaic application but some films include pinhole. The bath preparation order for obtain homogeneous film without pinholes will also be discussed for high efficiency thin film solar cells.

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PB055

Surface Resistance of Electro and Thermal Annealed ITO/Au/ITO Multilayered Thin Films

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Transparent conducting oxides (TCOs) have wide range of application areas in industry and science [1, 2]. Indium tin oxide (ITO) thin film is one of the most commonly used materials among the TCO thin films due to its relatively low resistivity and high optical transmittance in the visible region of the em spectrum due to its large bandgap of about 3.70 eV. Large area coating magnetron sputtering system is the commonly used and advantageous thin film growth method for the deposition the ITO thin films [3]. Multilayer transparent electrodes, having a much lower electrical resistance than the widely used transparent conducting oxide electrodes [4, 5]. ITO/Au/ITO multilayers have been prepared onto conventional soda lime glass substrates by sputtering. In our study, we used high vacuum based large area magnetron sputtering system for the ITO deposition [3, 4]. Au deposition performed another high vacuum system [3]. The optical and electrical characteristics of single layer and multilayer structures have been investigated as a function of the Au film thicknesses. Transmittance and sheet resistance values are found mainly dependent on the Au film thicknesses. Morever, effects of Electro [5] and thermal [3] annealing on ITO/Au/ITO multilayer thin films in vacuum ambient were investigated at low temperature range (50- 150 °C). The structural characterization of the thin films was carried out by an x-ray diffractometer (XRD) with CuKα radiation. The optical properties of the thin films were measured by a Spectrophotometer in the 2600-200 nm wavelength range. The thicknesses of the films were measured by a surface profilometer. Sheet resistance (R_s) of as grown, electro-annealed and thermal-annealed thin films were measured by four point probe method.

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PB056

Deposition of ITO Thin Films by Large Area DC Magnetron Sputtering

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[keywords] ITO, Large Area DC Magnetron Sputtering

Among transparent conductive oxides (TCO), indium tin oxide (ITO) is widely preferred because of its unique properties such as high transparency in the visible region and low resistivity. ITO thin films are used in many applications such as OLEDs, LCDs, Solar Cells, plasma display panels, transparent heat reflecting and electrochromic windows [1-2]. The main goal of this study is to grow ITO thin films with good electrical and optical properties on large area substrates. The growth of ITO with excellent electrical and optical characteristics by DC magnetron sputtering on small area such as microscope glass (2 x 2 cm^2) is very well controlled [3-4]. However, growth of ITO on large areas, required by industrial needs, is quite complicated.

In this work, we explored the effects of vacuum annealing on structural, electrical and optical properties of large area coated ITO thin films. The growth was carried out on 2, 3 and 4 mm thick and 90 x 60 cm^2 regular window glasses using rectangular magnetron sputtering source. We grew thin films with various thicknesses (e.g. 20 nm and 70 nm) and applied annealing process to them. Annealing was done in a chamber pumped with turbo molecular pump down to 2.0×10^{-6} Torr. The samples were heated to set temperature and kept at that for exactly one hour. We observed that with the increasing annealing temperature, the crystallizations of the ITO film in the (222) plane. The crystallizations were also observed in other orientations of In_2O_3 polycrystalline structure with annealing temperature above 200° C.

The transmittance of the samples was measured by a spectroscopic ellipsometer in the range of 280 to 850 nm. The observed transmittance was about 75% in the visible region including 4 mm thick glass. The high transmittance is associated with the large band gap of the ITO which was about 3.67 eV and it was found from transmission spectra. We also used van der Pauw method to measure the temperature dependent resistivity of the photolithographically patterned films. The measurements were done in 77-300 K range. From the measurement we found that the resistivity was better than 2.8×10^{-4} ohm.cm at room temperature. The resistivity vs. temperature behavior of the films was similar to that of metals i.e. the resistivity increased with the increasing temperature [5].

Recently, we improved the growth method in our large area rectangular magnetron sputtering system by employing a heating during deposition process [6]. As large as 60x90 cm^2 area ITO thin films were grown at heated substrates without necessary ex-situ heat treatment with electrical, optical and mechanical characteristics comparable to state of the art ITO thin films.

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PB057

Effect of Process Parameters Carburizing on Microstructure and Microhardness in Surface Layers of Steels

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[keywords] Carburizing, steel, Iron carbide.

Carburizing technique has been applied for the low carbon steels. it improves the mechanical properties surfaces of these materials at point of view wear and fatigue resistance. The resultant carburized surface region is characterized by the high saturation of carbon in austenite lattices of steel. Carburization which is one of the oldest heat treatments used for surface hardening was developed for further improvement of the mechanical properties of the work piece in particular the cutting tools [1]. The purpose of this technique is to increase the hardness and wear resistance of the surface by enriching the case with higher rate of carbon with subsequent quench hardening; the core of the object, which has not been impregnated with carbon, remains very ductile. Carburising treatment is the addition of carbon element to the surface of low-carbon steels at high temperature. Hardening is accomplished when the high carbon surface layer is quenched to form martensite so that a high-carbon martensitic steel with good wear and fatigue resistance is superimposed on a tough, low carbon steel core [2]. The depth of carburized steel depends of temperature, time and the available carbon potential at the surface. When prolonged carburising times are applied, a high carbon potential produces a high surface carbon content, which may thus result in excessive retained austenite or free carbides. The work of this study is to obtain cemented steel by pack carburizing treatment. Various time, temperature and nature of steel were used as parameters carburizing treatment. During this treatment, carbon atoms of powder pack which are present in a great quantity at the surface of low steel diffuse towards the steel in order to combine itself with the iron to form the iron carbide compounds. Effects of carburizing time and temperature on transformation rates of low steel to cemented steel layers were investigated. Micrographs of the samples and thickness of the carburised areas were analyzed by optical microscopy. The structures of different samples were analyzed by X-ray diffraction. The microhardness of cross section of cemented steel samples was measured by using micro Vickers.

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PB058

Temperature Dependence of Resistivity and Hall Coefficient in Cu_2ZnSnS_4 for Thin Film Solar Cells

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Keywords: Thin film solar cells, Cu_2ZnSnS_4 (CZTS), Sputtering, Electrical characterization

Cu_2ZnSnS_4 (CZTS) is a p-type intrinsic semiconductor compound that is stable in kesterite structure. CZTS has high band-gap energy around 1.5 eV, a large absorption coefficient ($\geq 10^4$ cm^{-1}) in the visible range of spectrum [1,2]. CZTS absorber layer attracts so much attention in photovoltaic industry since it contains earth abundant, low cost and non-toxic elements contrary to other chalcopyrite based solar cells such as $CuIn_xGa_{1-x}(S,Se)_2$ and CdTe. According to Shockley–Queisser theoretical calculations, 30-32% conversion efficiency is expected from CZTS solar cells [3]. Although, CZTS studies have been newly started, 12.6 % efficiency has been already achieved [4]. It means that more research is needed to be done with this newly explored material to improve its efficiency. In this work, we investigated structural, morphological, electrical, and optical properties of CZTS thin films grown on soda lime glass substrates by sulfurization of metallic precursors, which were sputtered in the multi-target sputtering system [5]. X-ray diffraction and Raman spectroscopy measurements revealed the formation of kesterite structure. A good crystallinity and grain compactness of the film was determined by scanning electron microscopy. Electrical properties were measured by using using four point probe and Van der Pauw techniques. CZTS samples demonstrated p-type semiconducting material behaviour and the resistivity of the films were measured between 0.1-1.89 Ω.cm values at room temperature. This study mostly focused on temperature dependence of electrical properties of CZTS semiconductor.

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PB059

Polyol-assisted Electroless Plating of Silver Nanoparticles onto Silicon Carbide Micropowder

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[Keywords] Porous SiC, electroless Plating, Etching process, UV irradiation

The main aim of this study is the production of porous silicon carbide via an electroless process for an eventual utilization in nanoscale blue light emiting diode. Results in the literature have shown a variety of porous morphologies of SiC produced on it thin film form using anodic cells [1, 2]. We investigated here an electroless etching method for producing porous silicon carbide powder under UV irradiation. Unlike in thin films, depositing electrical contact on microparticles is difficult to realize. The electroless process was chosen because it does not require electrical contact during etching like in anodic one. To do it, Silver nanolayer coated SiC microparticles was formed by polyol process prior the etching process using $AgNO_3$/NaOH and Ethylene glycol mixture. No surface sensitization was carried out on the SiC microparticles like it used to be done before electroless plating [3]. The Ag nanoparticles served both as an anode, catalyst and mask for the reduction of a chemical oxidant. The Ag–coated SiC microparticles were characterized by scanning electron microscopy (SEM), energy dispersive spectrometry (EDS), and X-ray diffraction (XRD). The etchant was composed of HF and different oxidants in water. Various porous morphologies are presented and studied as a function of etchant concentration, oxidant type, etching time, and wavelength of irradiation. We concluded that the chemical etching conditions of SiC powder seems to have a large impact on the resulting properties. We noticed that Ag-coated SiC powder etched under UV light of 365 nm using $K_2S_2O_8$ as oxidant, at reaction temperature of 80°C for t=40min exhibited the best photoluminescence property.

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PB060

ICP-CVD Grown Nanostructured Carbon Films

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[keywords] Carbon, Nano-Structure, ,Nanowalls, Plasma, Glow Discharge, CNT, CNF. ICP-CVD

Carbon Nanostructures are a key material in a wide range of nano-technological applications covering electronics, sensors, energy conversion and storage, biomedical and composite materials etc [1]. With a simple inductively coupled plasma chemical vapor deposition (ICP-CVD) system working at 13.56 MHz, carbon nanostructures have been deposited on various substrate types using liquid hydrocarbons as carbon source material and Argon as carrier gas [2], [3]. Dependence of the resulting nanostructures on the deposition conditions as well as on the hydrocarbon type has been observed.

The deposition system will be described. Ethanol, Benzene, Toluene, Para-Xylene in different concentrations in Argon and at different radio-frequency excitation power have been used for depositions on top of various substrates, e,g. glass/metal coated-uncoated, Si-crystal with and without metal coated, glassy carbon, graphite, steel, Aluminum etc. SEM, TEM and Raman spectroscopic results depending on the growth conditions showed remarkable structural differences ranging from columnar structures containing nano- tubes, fibers, cones and walls. The correlation between the structural formation and the growth conditions will be presented.

Catalysts have been also used as dissolved component in the precursor liquid and as a pre-deposited film on the substrate. Case studies were made without catalyst at all. Results will be shown and the necessity to use a catalyst and its consequences will be discussed.

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PB061

Adhesion Improvement for Parylene Layers by Plasma Pre-Treatment and Sample Handling over a Load-Lock System

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[keywords] Parylene, plasma, magnetron, adhesion, passivation, EIS

Parylene is the most effective final passivation coating for electronic circuitry, medical and even for some precision mechanical devices. Furthermore, it is a substrate material for medical and biological micro-sensors. The main shortcoming in technological applications is the poor adhesion of the films on any type of substrate material. [1]

Here, a unique system will be presented, which combines over a high vacuum load-lock three separated reaction chambers. Loading of substrates takes place over the load-lock as well in order to avoid venting of any of the reactors during loading and sample transfer in-between. Magnetron enhanced AF plasma pretreatment is performed in the first reactor. Subsequently, samples are shifted via the high-vacuum load-lock into the Parylene deposition chamber for coating. [2], [3]

An overview of the deposition system will be presented. Adhesion values are found higher than ever reported in the literature. Some further properties of the films improved by the reduction of the Oxygen background of the reactors and detected mainly by EIS will be mentioned briefly. Some application examples will be shown. [4]

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PB062

Tungsten Oxide−Organic Framework Thin Films Composed of Hybrid Nanofibers Exhibiting Reversible Electrochromism

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[keywords] tungsten oxide, conducting polymer, ionic liquid, electrodeposition, hybrid nanofiber, electrochromic device

High-quality hybrid nanofibers were fabricated with the aim of studying their feasibility as electrochromic systems. This proof-of-concept study focuses on the electrodeposition of two conducting polymers, namely, poly(3,4-ethylenedioxythiophene) (PEDOT) and polypyrrole (PPy), in nanostructured inorganic semiconductor host matrix, tungsten trioxide. Tungsten oxide/conducting polymer films were electrochemically synthesized into four different ionic liquids: 1-butyl-3-methylimidazolium tetrafluoroborate ($BMIMBF_4$), 1-butyl-3-methylimidazolium hexafluorophosphate ($BMIMPF_6$), 1-butyl-3-methylimidazolium bis(trifluoromethylsulfonyl) imide (BMIMTFSI), and 1-butyl-1-methylpyrrolidinium bis(trifluoromethylsulfonyl) imide (BMPTFSI), followed by electrospinning deposition. The influence of ionic liquid on the morphology of formed hybrid nanofiber samples was observed by scanning electron microscopy (SEM) measurements. Energy dispersive X-ray spectroscopy (EDX) was also employed to confirm the compositions of nanofibers. Electrochromic devices fashioned from these hybrid nanofiber arrays were found to display remarkable electrochromic performance with reversible color change, fast optical modulation and superior cycling stability. These improvements can be attributed to the high porosity of the nanofibers, their larger accessible surface area for Li^+ intercalation and deintercalation and rational combination of two electrochemically active materials [1]. WO_3/PEDOT/$BMIMPF_6$ based device showed marked enhancement of electrochromic contrast and coloration efficiency over other nanofiber based devices: the transmittance change of 47.89% along coloration efficiency of 363.72 cm^2/C. These unique organic−inorganic nanostructures with synergy pave the way for developing new functional materials with enhanced properties or new applications [2].

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PB063

Terahertz Response Properties of Microwave Kinetic Inductance Detectors (MKIDs) made of Ultrathin Superconducting Films

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[keywords] kinetic inductance, terahertz waves, detector

Terahertz spectrum between microwaves and infrared, is to be expected not only for wireless broadband communication but also for various kinds of imaging and analytical applications in security, medicine, and agriculture as well as material sciences. However, there is no imaging device satisfying both of the speed-speed and high-sensitive performances for terahertz waves. Microwave kinetic inductance detectors (MKIDs) originally developed for ultra-sensitive microwave detectors for radio astronomy purpose is a possible candidate of terahertz sensitive detector arrays with the easy multiplexing capability and simple device structure consisting of a superconducting monolayer. We propose NbN superconductor-based MKIDs as a sensitive terahertz imaging array. Although MKIDs were originally developed for ultra-sensitive microwave detectors for radio astronomy purpose, we invented a revolutionary MKIDs with a characteristic structure consisting of a superconducting rewind spiral indicating dual functional roles of microwave resonator as well as wide range terahertz antenna named “Spiral-MKIDs”. It is expected that the Spiral-MKIDs fabricated of few ten nanometers thick NbN film reveals NEP in the order of 10^{-14} W/√Hz above ~1THz corresponding to the energy gap frequency of NbN. The NbN-based Spiral-MKIDs can be operated using a commercially available liquid He free refrigerator. We present terahertz response properties of Spiral MKIDs made of ultrathin NbN films. Thickness of terahertz sensitivity of the NbN-Spiral MKIDs will be discussed.

PB064

Micro Arc Oxidation Coatings on Mg alloy with addition of Nano-Al_2O_3 Additive

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Micro Arc Oxidation, Nano additive, Magnesium Alloy, Microstructure

Electroplating and electroless plating, physical vapor deposition, plasma electrolytic oxidation (micro arc oxidation), organic coatings and vapor-phase processes have used to improve magnesium alloys, such as corrosion and wear resistance [1-3]. Micro Arc Oxidation (MAO) is considered one of the most effective processes to coat Mg alloys using an environmental friendly technique for enhancing the properties of Mg alloys [1,2,4].

In these study, ceramic coatings were prepared on Mg alloy by micro arc oxidation (MAO) in silicate electrolytes with and without Al_2O_3 nano additive. Effects of nano additive on the structure, phase composition, hardness of the MAO coatings were analyzed by scanning electron microscopy, X-ray diffraction, micro-hardness test, respectively. The results showed that the nano additive solution has an important role on surface morphology of MAO coating. The SEM show that coatings with nano additive have lower porosities than without nano additive coatings. XRD results display that nano additive coatings contain more oxide when compared to without nano additive coatings. Nano particles addition improve the hardness of MAO coatings.

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PB065

Protective Properties of Poly(N-methylpyrrole) Film on ZnNi Plated Carbon Steel

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[Keywords] Alloy plating, corrosion, poly(N-methylpyrrole)

Corrosion is a problem of great economic importance to industry. Therefore, metallic platings such as zinc, nickel and their alloys have been widely used to protect metals like copper, iron and mild steel against corrosion, for many years. Electrochemically synthesized conducting polymers have also been studied for their potential use as anticorrosive coatings [1-2].

In this study, zinc–nickel (ZnNi) particles were electrochemically deposited on carbon steel (CS) electrode applying current of 1 mA with chronopotentiometry technique. Poly(N-methylpyrrole) film (PNMP) was synthesized with cyclic voltammetry technique from 0.10 M N-methylpyrrole containing 0.20 M sodium oxalate solution on CS/ZnNi electrode. The corrosion performances of coated and uncoated electrodes in 3.5 % NaCl solution were evaluated with the help of AC impedance spectroscopy (EIS) and anodic polarisation curves. Scanning electron microscopy (SEM) and linear sweep voltammetry (LSV) were used to characterization of coatings. It was shown that the ZnNi particles exhibited important barrier effect on CS substrate. The polymer coatings exhibited an effective barrier property and a remarkable anodic protection to substrate for longer exposure time.

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PB066

Optical Constants and Optical Dispersion Parameters of Calixamide Nanofibers By Electrospinning

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[keywords] Optical properties, Calixarene, nanofiber

This study reports the synthesis of three novel polyacrylonitrile (PAN) nanofibers based calixamide containing pyridine groups by electrospinning. The structures of the newly prepared nanofibers were clarified using spectroscopic techniques. Analysis indicated that preparation of nanofibers based calix-amide was successfully achieved. The presence of calixarene molecules in the nanofiber backbones was confirmed by Fourier transform infrared (FTIR-ATR), scanning electron microscope (SEM). In-depth characterization has indicated that pure stoichiometric PAN nanofibers are non-beaded randomly grown fibers with diameters ranging from 261 to 311 nm. The fiber diameters are not homogeneous and uniformly distributed. We have analyzed the optical transmission and reflection spectra of nanofiber thin film between 250-2000 nm wavelength range. The optical absorption coefficients and band gaps of the films were estimated by optical transmission and reflection measurements at room temperature. Strong absorption coefficients in the range 105–6cm-1at 1000 nm were found. The direct gaps E_g lie between 3.90–4.01 eV range. It is observed that there is a decrease in optical band gap E_g with increasing calixester and amide amount.

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PB067

A New Helium Diffraction System Setup to Characterise Pfp Films

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Due to their promising properties in electronic device applications, such as thin film transistors (TFTs), light emitting diodes (LEDs) and solar cells, organic semiconductors (OSs) are being studied heavily. With helium diffraction systems as compared with other diffraction systems (such as electron diffraction and x-ray diffraction), due to having low energy He atoms, surface crystal structure can be investigated without deforming thin film surfaces. In this study, we aim to present construction of a new helium diffraction system, to investigate the structural properties of perfluoropentacene (PFP) thin films on flat and vicinal Au(111) and Ag(111) surfaces as a function of film thickness, metal surface step density and molecular flux and energy during film growth which will enable us to determine the growth parameters that yield the highest quality PFP films.

PB068

Temperature Triggered Transparency of THz Filters based on Vanadium Dioxide Thin Films

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[keywords] Vanadium dioxide, terahertz waves.

Terahertz (THz) technology plays important role for many diverse applications, but there is still lack of sources, detectors and filters that operates in this region [1-2]. In earlier studies, simple tunable THz filters have been developed. However, the transmittances and resonance frequencies of such devices are difficult to be further tuned since the metallic structures are used. Therefore, metallic filters can only be used as passive THz devices. Among the active, THz-agile materials, vanadium dioxide (VO_2) shows promising potential for switchable photonic and THz devices. VO_2 exhibits metal-insulator phase transition (MIT) which can be initialized by temperature, electrical field and light. The transition occurs at nearly 68 ^oC [3]. The resistivity of VO_2 abruptly changes by a factor of 10^4 at T_{MIT}. Furthermore, the optical properties of the material in IR and THz region change as depending on the temperature. In this work, high quality VO_2 thin films were deposited on c-Al_2O_3 and fused silica substrates by dc magnetron sputtering technique. In order to determine structural, optical and electrical properties of grown films, various analyses carried out at between 25 and 100 ^oC for two different crystal structure of VO_2. MIT in VO_2 was observed with the change in resistivity by a factor of 10^4. We propose a unique geometry (quadcross shaped) for the conductive layer that can be used as a metamaterial device operating in the THz frequency range. The metamaterial consists of a rectangular structure with strip lines at sides of the ring on a dielectric substrate. Then, VO_2 films were shaped by electron beam lithography (EBL) in order to create designed filter structure. The spectral performances of these filters were investigated experimentally using both a THz time domain spectrometer and a Fourier transform infrared spectrometer (FTIR). Commercial electromagnetic simulation software, CST Microwave Studio, was used to verify the experimental data. Our results show that the transmittance of the quadcross shaped filter can be actively tuned by the temperature triggered metal–insulator phase transition of VO_2.

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PB069

$Bi_2Sr_2CaCu_2O_{8+x}$ Thin Films Grown by DC Magnetron Sputtering for Terahertz Applications

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[Keywords] Bi2212, Superconducting thin films, Terahertz radiation, DC magnetron sputtering.

There is a growing interest and technology of electromagnetic waves in terahertz frequency region (0.1-10 THz) due to their variety of application areas in the physical, astronomical, medical and biological sciences, including imaging, spectroscopy, information technology, medical diagnosis and the detection of explosives [1]. In the desired regime, superconducting devices are excellent candidates due to their distinctive advantages of extremely low noise, low power consumption and high frequency operation [2-4]. In addition to these, although high-T_c superconducting low-loss metamaterial devices have been designed, high-T_c superconductor thin films based on Bi2212 ($Bi_2Sr_2CaCu_2O_{8+x}$) have not been utilized. In this study, our goal is to develop sources, detectors and narrow band THz band-pass filters based on superconducting metamaterials. For this purpose, the Bi2212 superconductor will be grown and optimized on MgO and sapphire substrates by using DC magnetron sputtering technique. Using deposition systems, the Bi2212 target pellets will be prepared through the calcination, press and sintering of stoichiometric concentrations of Bi_2O_3, $SrCO_3$, $CaCO_3$ and CuO powders. The annealing of the superconducting films is accomplished at various temperatures in an oxygen flow furnace. The thicknesses of the thin films thus obtained ranges from 200 nm to 600 nm obtained from cross section of the SEM images. The composition of the film was investigated using Energy Dispersive X-ray Analysis (EDAX). The EDAX studies of this film showed stoichiometry close to 2212 composition. The crystal structure of the films was investigated by X-ray diffraction (XRD), and the crystallinity of the films was estimated from the full-width at half-maximum (FWHM). The resistivity measurements were carried out using closed-cycle liquid helium cryostat with programmable temperature controller.

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PB070

Effects of Substrate Temperature on Material Characteristics of Sputtered Aluminum doped ZnO Thin Films

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[keywords] thin film, annealing, sputtering, transparent conductive layer.

Transparent conductive layers (TCOs) attract the attention in opto-electronic and photovoltaic device applications due to their conductivity and transparency characteristics in the visible region of the solar spectrum. There are various TCO thin film layers, and indium tin oxide (ITO) and aluminum doped zinc oxide (AZO) are the most popular thin films such as the desired material characteristics of SnO_2 and ZnO, respectively. In literature, the works indicated that the characteristics of these films can be changed by using different deposition techniques. In this work, sputtering technique was used to fabricate the AZO film samples. AZO film samples were deposited on the ultrasonically cleaned commercial soda lime glass substrates at the substrate temperature of 300-573 K. The samples were fabricated by using DC/RF magnetron sputtering system. In general, the work was concentrated on the structural, electrical and optical properties of the AZO thin films with respect to the substrate temperature. In addition, post-annealing processes were applied to investigate the annealing effect on the material properties. The characterizations of the thin films were done by X-ray diffraction (XRD) and energy dispersive X-ray spectroscopy (EDS) for structural analysis, UV/Vis transmission measurements for optical analysis and dark conductivity measurements for electrical analysis. In XRD spectra, all the deposited thin films were found highly oriented in the (002) orientation direction. By using transmission values, band gap energies of the films were investigated under the effect of substrate and annealing temperature. According to corresponding Tauc plots, the value of the band gap of AZO thin films increased with increasing deposition temperature. In addition, electrical measurements were done by four-point probe system and the electrical resistivity of the AZO films were quite sensitive to the substrate temperature and the value of resistivity values were found in decreasing behavior with increasing deposition temperature.

PB071

Magnetron Sputtered Thin Film of Shape Memory Alloys and Their Characterizations

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Cu-based shape memory (SM) alloys are attractive systems for the practical exploitation of the effect and stand next in line to the Ni-Ti (Nitinol) base alloys as suitable alloys for SM applications because of their lower cost and reversible properties in different situations[1]. Cu-based shape memory alloy (Cu-12.5%Al-5%Mn in %wt) was grown on soda lime glass and polymer substrates as the thickness of 200 nm to 1 um by magnetron sputtering technique and then grown thin film layer separated from substrate surface for annealing operation at 500, 600, 700 $^{\circ}$C 5 to 7 hours. So that annealed thin films investigated by SEM and XRD analysis. XRD results showed that increasing the coating procedure time leads to a reduction in crystalline size and increase in lattice parameters[2][3]. SEM analyses shows surface micrograph of various annealing operation time effects on coating roughness and porosities amount.

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PB072

Characterization of ~400 nm thick FeSe thin films fabricated by thermal evaporation method

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FeSe thin films were grown by thermal evaporation method on single crystalline MgO (001) substrates. Structural, electrical and magnetic properties were investigated. According to XRD results we obtained only *c*-axis peaks without any impurities or any other non-superconducting phases. From the results of electrical resistivity measurements, the values of T_c in films are about 14 K. This is approximately 5 K better than the single crystalline bulk samples. Magnetic properties were also showed better performance than the bulk samples. The critical current density of the samples, as calculated using the *M-H* curves and Bean's model reached to 1.31×10^6 Acm^{-2} showing that approximately 10 times better performance than the bulk single crystalline form of the FeSe alloys.

PB073

Layer by layer formation and characterization of $FeTe_{0.5}Se_{0.5}$ single crystalline thin films prepared by thermal evaporation technique

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Multilayer $FeTe_{0.5}Se_{0.5}$ thin films grown on $SrTiO_3$ substrates by thermal evaporation method successfully. Structural, electrical and magnetic properties were investigated by XRD, XRD-Pole Figure, SEM-EDX and Physical Property Measurement System (PPMS-9T) up to 9 T. XRD and XRD-Pole Figure investigations showed a tetragonal symmetry with 4 quadrant pole formation on the *c*-axis of the film surface. Electrical and magnetic properties exhibit a greatly enhanced superconducting properties, T_c=18,9 K, over that found in bulk $FeTe_{0.5}Se_{0.5}$ single crystalline bulk samples. By using the *M-H* curves and the Bean's extended model the critical current density J_c^{mag} over 1.42×10^6 A cm^{-2} at 4 K was obtained. Magnetic flux penetration measurement reveals that the current is almost isotropically distributed in the bulk of the thin films. Ginzburg-Landau parameter was found to be $\xi(0)$ = 2.79 nm which indicates unconventional nature of superconductivity for the samples produced. These results were found to be promising for future electronic applications of $FeTe_{0.5}Se_{0.5}$ thin films.

PB74

Graphene Based Wide-Band Metamaterial Absorber for Solar Cells Application

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[Keywords] graphene, metamaterial absorber, solar cells.

Presently, metamaterials (MTM) have gained significant importance due to their electromagnetic properties and for their numerous potential applications in electromagnetic industry [1-2]. MTM based absorbers have demonstrated ability to produce high (near perfect) absorptivity which enabled the creation of novel absorber devices, including high absorber solar cells [3-4]. On the other hand, adding a graphene monolayer sheet on the metamaterial absorbers cause enhancement of their absorption coefficient and bandwidth. Interesting electronic transport properties far better than those of metals and semiconductors, high conductivity and excellent mechanical properties of graphene made it a good candidate in metamaterial industry where graphene sheets are used in metamaterial absorber designs in order to manipulate the propagating path of electromagnetic waves and enhancement of absorption characteristics of MTM absorber structures [5-6].

In this work a wideband MTM absorber structure with nearly perfect absorption coefficient in the visible frequency region of the solar spectrum is proposed and numerically characterized. The proposed design consists of four basic components which are concentric circular ring resonators (made of gold and GaAs), glass Pyrex lossy, ground metal (gold) and dielectric spacer (GaAs).The numerical simulation results of the proposed MTM structure give a near perfect absorption rate (99.9%) at the resonant frequencies. Replacing glass Pyrex lossy layer and also by covering the surface of circular ring resonators with graphene sheet increase the absorption rate and bandwidth of the proposed MTM absorber design up to 26%.

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Izmir Institute of Technology	Bahadır Yaldiz, Secretary General	Izmir Institute of Technology is one of the state universities in Turkey.	bilgi@iyte.edu.tr	http://iyte.edu.tr/
Teknoma Technological Materials Company, Inc.	Prof. Dr. Lütfi Özyüzer, Director	Research fields consist of thin films, surface coating vacuum technologies technological/smart materials, polymers, ceramics and composites based materials. At the same time, coating units, vacuum systems and parts with sputter, ion beam etc. systems can be manufactured depending on order	info@teknoma.net	http://www.teknoma.net/
NanoMagnetics Ltd.	Prof. Dr. Ahmet Oral, Director	NANOMANYETİK BİLİMSEL CİHAZLAR LTD. (NMI) is one of the world leading companies in the field of Scanning Probe Microscopes (SPMs) and measurement systems for various field of science and technology. Founded in 1999 as the first nanotechnology spin off in Turkey, markets its products in the world under NanoMagnetics Instruments Ltd. brand, which is a fully owned subsidiary. Prestigious universities like Oxford, MIT, Kyoto, and Harvard research labs like, Los Alamos National Lab., Argonne National Labs, TATA- Institutes, government institutes like NASA and companies like Seagate, Microsoft, and Samsung are among our customers. 4 universities in top 10 list and 20 universities in top 100 list are our customers. A team, composed of various branches of science and engineering, gives us the expertise required for R&D and manufacturing. System design, development, manufacturing, assembly, integration and testing are done in house for mechanical, electronics and software requirements. Our product portfolio is mainly composed of • Ambient Scanning Probe Microscopes (SPMs) • Low Temperature Scanning Probe Microscopes SPMs • Controller & Standalone Electronics • Measurement, Characterization & Manipulation Systems • Custom Manufactured Systems & Parts	bilgi@nano.com.tr	http://www.nanomagnetics-inst.com/tr
Teknotip Analitic Systems	Erman Yenihayat	The company is working in the fields of Nanotechnology, Bio-Chemistry, Bio-Genetics, Polymer Industry, Super Critical Liquid Reactors and Radiation Oncology with its strong partnership with world leading companies presenting high-tech systems well-known by their durability and reliability all over the world.	eyenihayat@teknotip.com.tr	http://www.teknotip.com.tr/

UKAM	Prof. Dr. Lütfi Özyüzer, Director	UKAM (Applied Quantum Research Center) is scientific research area center at Physics Department of IZTECH. At UKAM, the availabilities of facilities are class 1.000 and 10.000 clean rooms, electron beam lithography (EBL) and X-ray photoelectron spectroscopy (XPS). Research interests are characterization and design/fabrication of lab-on-a-chips, nano-devices and thin films.	lutfiozyuzer@iyte.edu.tr	http://ukam.iyte.edu.tr/
Nanovak	Prof. Dr. Hüseyin Durusoy, Director	Nanovak produces global products to meet the needs of its customers. Innnovative approaches and engineering techniques are employed to design and manufacture high quality vacuum and thin film products.	bilgi@nanovak.com	http://nanovak.com/
Techno Plasma	Prof. Dr. Lütfi Öksüz, Director	Applications of Plasma Energy Ltd. Co., which is constructed in Göller Bölgesi Teknokent by the instructor Prof. Dr. Lütfi Öksüz in Physics Department of Süleyman Demirel University. The company is continuing its research and development facilities with success. Industrial and scientific device production, import-export activities are maintained by the company. The subject of the production consists of Thin Film Deposition Systems, Vacuum Systems, Plasma Sytems, E-beam/ Ion Beam Systems, and special system designs for the private projects. Furthermore, Plazmatek conduct researchs on nanotechnology subject which has become the world's focus nowadays and also make production of the related innovative device designs.	lutfioksuz@sdu.edu.tr	http://plazmatek.com/
MEMS	Mehmet Turken	MEMS organization supplies high technological equipment and instruments in the field of nanotechnology, electric and electronics, physics and material science.	mehmet.turken@mems.com.tr	www.mems.com.tr
Raith	Andreas Remscheid	Raith offers innovative instrument solutions for electron beam lithography, ion beam lithography, nano manipulation, electron beam induced deposition and etching.	remscheid@raith.de	http://www.raith.com/
Kenar Müh.	Necmetin Kenar	Research areas are optic, laser, plasma, vacuum systems.	info@kenarmuhendislik.com.tr	http://www.kenarmuhendislik.com.tr/
Alser Teknik	Naşit Çiner	To supplier of furnaces and temperature controller systems.	alser@bim.net.tr	http://www.prothermfurnaces.com/
Testone	Seda Çiçek	The company supplies test and analyses devices.	info@testone.com.tr	http://www.testone.com.tr/
Nanosan Instruments	Numan Akdoğan, PhD International Sales Manager	Nanosan Instruments is supplier of analytical instrumentation solutions for nanotechnology research and development. The company produce smart, user friendly and multifunctional instruments with state-of-the-art performance and combine analytical tools into sophisticated systems.	info@nanosan.com.tr	http://nanosan.com.tr/
Beam-Ar-Ge	Prof. Dr. Arif Demir	Beam Ar-Ge supplies optic, laser, spectroscopy instruments.	info@beamarge.com	http://www.beamarge.com/
Testhermoelectric	Prof. Dr. Raşit Ahiska, Director	Research area is new generation thermoelectric systems.	info@testhermoelectric.com	http://testhermoelectric.com/

Entekno	Oktay Uysal, Manager	ENTEKNO Industrial Technological and Nanomaterials Inc. is a dynamic, innovative spin-off company founded in March 2008 at the Eskisehir Technological Development Region to perform high quality research and hence, to develop and commercialize novel functional, environmentally friendly advanced materials -including nanomaterials- and materials systems for sustainable growth.	info@enteknomaterials.com	http://www.enteknomaterials.com/
Nova Analitik	Murat Aldemir, Director	Nova Analitik supplies analytical instruments and relevant materials.	info@novaanalitik.com	http://www.novaanalitik.com/
Vaksis	Seher Çelik	VAKSIS is a high technology company which is located at the Technopark of Bilkent University. We design and manufacture vacuum and thin film coating systems by using thin film deposition techniques for the solar energy, electronics, automotive, optics, medical, semiconductor and related high technology industries. Our advanced manufacturing technology includes Physical Vapor Deposition (PVD), Chemical Vapor Deposition (CVD), Reactive-Ion Etching (RIE), Rapid Thermal Annealing (RTA) techniques, etc. Each system is designed based on the requirements of our customers and is the proof of accumulated knowledge and experience over the years in these fields. Our customized systems are used efficiently and effectively in many universities, institutes and industrial R&D laboratories. VAKSIS not only manufactures systems for different needs and requirements, but also creates innovative, durable as well as flexible and user friendly systems. We also provide warranty and technical service after delivery of the products.	info@vaksis.com	http://www.vaksis.com/
Rotalab	Demet Catcat	Rotalab Scientific Instruments is a leading provider of analytical instrumentation and equipments for research laboratories and industrial organizations in Turkey. The major fields of activity of Rotalab are nanotechnology, physics, chemistry, materials science, life science and optoelectronics. Rotalab's product range includes hundreds of high technology analytical instruments. Our products consists of electron microscopes particularly field emission scanning electron microscope (FE-SEM), atomic force microscopes (AFM), optical microscopes, raman microscopes, plasma systems, fourier transform infrared spectroscopy (FTIR), atomic absorption spectrophotometer, micro-volume spectrophotometer (nano-drop) and other spectrophotometer systems, tribology instruments, nanoindenters, profilometers, raman spectrometers, mass spectrometers, lithography systems, PV/IV systems including light sources and solar simulators, furnaces, battery equipments, glove boxes, pump systems, thin-film thickness	info@rotalab.com	http://www.rotalab.com/en.html

		measurement systems, ellipsometry, thin-film coating systems, probe stations including cryogenic probe stations, C-V plotters, cryostats, microplate readers, ELISA analyzers, thermal cyclers, centrifuges, and many other analytical instruments. The satisfaction of our customers is our highest priority — whether in the further development of our product portfolio, in issues relating to our strategic orientation or with a view to service and support. Your demands, needs and wishes serve as a compass for us that we use to guide our actions as a company. As a market leader in many areas of analytical instrumentation in Turkey, we ensure that you are one of the first to benefit from new technologies. Rotalab is strongly committed to fully meet its customers' needs with fast and high quality service.		
Optikron	Ilghar Orujalipoor	OPTİKRON, in the industrial sector with over 45 years of accumulation and by the follow of technological developments very closely, company serves the R & D center and quality control departments , advise for the characterization of devices, and also provide sales and after sales services. Beside these services, OPTİKRON provides staff from relevant university departments about devices that used for characterization in micro and nano technology and also aimed to create the highest level "Customer Satisfaction" and continuity. OPTİKRON suggests Optic, Digital, Confocal and Electron Microscopes, Profilometer, XRD, AFM and Elipsometer from the world's most important manufacturers. So, the company gives opportunity to universities that have R&D and quality control centers and beside private sector to test and measure all kinds of material properties. Companies that we distribute in Turkey; HUVITZ: Optic and Digital (3D) Microscopes SENSOFAR: Contactless 3D Surface Profilometer (Confocal) SERON TECHNOLOGY: Scanning Electron Microscopes (SEM) ASYLUM RESEARCH (OXFORD INSTRUMENTS): AFM ANGSTROM ADVANCED: XRD ELLIPSO TECHNOLOGY: Elipsometer		http://www.optikronltd.com/
Creon	Ahmet Doğrusöz	CREON Advanced Technology and Engineering Inc. Co. is working in the field of laboratory systems and technologies, which is constructed in Istanbul by a group of engineers with 30 years of experience in this field. CREON, works on surface analysis systems, nanotechnology, advanced imaging systems, material characterization, and also gives scientific and technical support, and consultancy service to provide international standards for the academic and industrial research laboratories. Besides,	info@creon.com.tr	http://www.creon.com.tr/

		CREON, is a firm that shows international activities and expertise, aims to perform international quality standards by its collaborations with the world's leading companies. Our main goal is to understand requests of our customers and give response to their demands in international quality standards.		
Caves-Tek	Vildan Bilgin		info@ cavestek.com.tr	http://cavestek.com.tr/
Okyay Tech.	Tuba Okyay		info@okyayenerji.com	http://www.okyayenerji.com/
Terra Lab	Bülent Atamer		info@terralab.com.tr	http://www.terralab.com.tr/
AN-KA	Gökhan Aslıbay		an-ka@an-ka.com	http://www.an-ka.com/
Nanomat	Berkan Öztürk		info@nanomat.com.tr	http://www.nanomat.com.tr/en/
Plasmatreat	Hakan Sağkal		hakan.sagkal@plasmatreat.com.tr	http://www.plasmatreat.com/

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