SATF 2018

Science and Applications of Thin Films, Conference & Exhibition

September 17 to 21, 2018

Grand Ontur Hotel

Cesme, Izmir, Turkey

www.satf-conf.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 2018)"* being held in Grand Ontur Hotel, Cesme, Izmir, Turkey, from September 17 to 21, 2018.

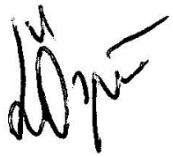
The first series of the conference, SATF 2014, was held at the Altin Yunus Resort & Thermal Hotel, Cesme, Izmir, Turkey, from September 15 to 19, 2014 and the Second series of the conference, SATF 2016 was held in Ilica Hotel Spa & Wellness Thermal Resort, Cesme, Izmir, Turkey, from September 19 to 23, 2016. First two conferences hosted above 700 scientists, and the proceedings were published in Vacuum, Applied Surface Science and Thin Solid Films. The main objective of the SATF conferences is to provide a valuable international platform for individuals to present their research findings, display their work in progress and discuss conceptual advances in many different branches of thin films.

SATF 2018 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. The selected Full-Text Manuscripts of SATF 2018 will be evaluated by scientific committee and published in SATF 2018 Proceeding Book. This conference is supported by TUBİTAK 2223B program.

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 Cesme 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 addition, we appreciate our sponsors for their generous support. In the spirit and tradition of Turkish hospitality, we once more welcome you all to SATF 2018, I would like to wish you a nice and enjoyable stay in the Cesme, may you all return home feeling recharged and ready to continue the invaluable explorations.

Best regards,



Lutfi Ozyuzer
Chair

Scope of the SATF 2018 Conference & Exhibition

The SATF 2018 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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Gulnur Aygun	IZTECH, TURKEY
Kamil Kosiel	Institute of Electron Technology, POLAND
John L. Reno	Sandia National Laboratories, USA
Mehtap Ozdemir	IZTECH, TURKEY

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Enver Tarhan	IZTECH, TURKEY

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Mehmet Ertugrul	Ataturk Univ., TURKEY
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Ugur Unal	Koc Univ., TURKEY
Roger Webb	University of Surrey, UK
Eyyuphan Yakinci	Iskenderun Technical Univ., TURKEY
John F. Zasadzinski	Illinois Institute of Technology, USA

Supporting Students

Bengü Ata	IZTECH, TURKEY
Merve Ekmekçioğlu	IZTECH, TURKEY
Hasan Köseoğlu	IZTECH, TURKEY
Ece Meriç	IZTECH, TURKEY
Aileen Noori	IZTECH, TURKEY
Sina Rouhi	IZTECH, TURKEY
Uğur Mert Ulutanır	IZTECH, TURKEY
Zemzem Uyanık	IZTECH, TURKEY
Yesim Alduran	IZTECH, TURKEY
Mehmet Yakar	IZTECH, TURKEY
Jose Enrique Martinez Medina	IZTECH, TURKEY

CONFERENCE PROGRAM

		Sept. 17, Monday
08:45-9:00		
09:00-9:30		
09:30-10:00		
10:00-10:20		
10:20-10:40		
10:40-11:10		
11:10-11:40		
11:40-12:10		
12:10-12:30		
12:30-12:50		
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
15:50-16:00		Registration
16:00-16:30		Registration
16:40-17:00		Registration
17:00-17:20		Registration
17:20-17:40		Registration
17:40-18:00		Registration
18:00-19:30		
19:30-20:30		DINNER
20:30-24:00		

	Sept. 18, Tuesday Convention A	Sept. 18, Tuesday Convention B
	SC: Lutfi Ozyuzer	
08:45-9:00	Opening Ceremony **Prof. Lutfi Ozyuzer** SATF2018 Chairman **Prof. Mustafa Guden** Rector of IZTECH	
09:00-9:30	**IS01: K. Nakajima**	
09:30-10:00	**IS02: A. Szerling**	
10:00-10:20	**CT01: A. Crisan**	
10:20-10:40	**CT02: S. Al Dallal**	
10:40-11:10	COFFEE BREAK	COFFEE BREAK
11:10-11:40	SC: Waldemar Nawrocki	SC: G. Karapetrov
	IS03: S. Erten Ela	**IS04: M. Akyol**
11:40-12:10	**CT03: A. Cantas**	**CT06: T. Sasmaz Kuru**
12:10-12:30	**CT04: A. Shushanyan**	**CT07: Ö. Çiçek**
12:30-12:50	**CT05: F. Turkoglu**	**CT08: Ugur Unal**
12:40-14:00	LUNCH	LUNCH
14:00-14:30	SC: H. Efeoglu	SC: A. Schuler
	IS05: A. Andreone	**IS06: G. Karapetrov**
14:30-14:50	**CT09: Y. Demirhan**	**CT12: Berrin Ikizler**
14:50-15:10	**CT10: W. Nawrocki**	**CT13: Neslihan Akcay**
15:10-15:30	**CT11: E. Özdemir**	**CT14: H. Hajihosseini**
15:30-15:50	COFFEE BREAK	
15:50-16:00		
16:00-16:30	SC: M. A. Sahiner	SC: M. Egilmez
	IS07: A. Hassan	**IS08: F. Yildiz**
16:40-17:00	**CT15: S. Yiğen**	**CT18: S. Shawati**
17:00-17:20	**CT16: E. Meric**	**CT19: R.K. Brajpuriya**
17:20-17:40	**CT17: D. Bouhafs**	**CT20: M. Mebarki**
17:40-19:30		
19:30-20:30	DINNER	DINNER
20:30-24:00		

	Sept. 19, Wednesday Convention A	Sept. 19, Wednesday Convention B
	SC: P. Badica	SC: O. Saglam
08:45-9:00		
09:00-9:30	**IS09: A. C. Papageorgiou**	**IS11: J. Barth**
09:30-10:00	**IS10: K. Güven**	**IS12: S. Ida**
10:00-10:20	**CT21: N. Bulut**	**CT23: M. Can**
10:20-10:40	**CT22: N. Assigbe**	**CT24: K. Kosiel**
10:40-11:10	COFFEE BREAK	COFFEE BREAK
11:10-11:40	SC. M. Ozdemir	
11:40-12:10	**ŞIŞECAM Special Session** Prof. Dr. Sener OKTIK Ocal Tuna, Burcu Ogut, Ece Kurt	
12:10-12:30		
12:30-12:50		
12:40-14:00	LUNCH	LUNCH
14:00-14:30	SC: G. Aygun	SC: K. Kadowaki
	IS13: A. Schüler	**IS14: T. Basova**
14:30-14:50	**CT25: M. Kuru**	**CT29: Z. Ertekin**
14:50-15:10	**CT26: O. Saglam**	**CT30: N. Erdoğan**
15:10-15:30	**CT27: Tutku Saatci**	**CT31: Batuhan Mulla**
15:30-15:50	**CT28: S. Naama**	**CT32: S. Briche**
15:50-16:00	COFFEE BREAK & POSTER SESSION A	
16:00-16:30		
16:40-17:00		
17:00-17:20		
17:20-17:40		
17:40-18:00		
18:00-19:30		
19:30-20:30		
20:30-24:00	**Gala Dinner & Turkish Night**	

		Sept. 20, Thursday Convention A	Sept. 20, Thursday Convention B
		SC: P. Barbara	SC: U. Ünal
08:45-9:00			
09:00-9:30		**IS15: E. Yakinci**	**IS17: A. I. Martinez**
09:30-10:00		**IS16: Y. Takano**	**IS18: T. Iwayama**
10:00-10:20		**CT33: Y. Yesilbag**	**CT35: M. Akın**
10:20-10:40		**CT34: F. Tuzluca**	**CT36: M. Büyükbayram**
10:40-11:10		COFFEE BREAK	COFFEE BREAK
11:10-11:40		SC: Y. Takano	SC: M. Ozdemir
		IS19: A. Nabok	**IS21: G. F. de la Fuente**
11:40-12:10		**IS20: M. A. Şahiner**	**CT39: M. Weidner**
12:10-12:30		**CT37: P. Badica**	**CT40: A. Kramer**
12:30-12:50		**CT38: H. Efeoğlu**	**CT41: K. Yakinci**
12:40-14:00		LUNCH	LUNCH
14:00-14:30		SC: A. Ekicibil	SC: Musa Mutlu Can
		IS22: P. Barbara	**IS23: İ. Efeoğlu**
14:30-14:50		**CT42: R. Georgiev**	**CT46: E. Abakay**
14:50-15:10		**CT43: M. Ekielski**	**CT47: I. Ilyn**
15:10-15:30		**CT44: D. Mansuroğlu**	**CT48: Gokhan Gulten**
15:30-15:50		**CT45: A. Larabi**	**CT49: M. Mumtaz**
15:50-16:00		COFFEE BREAK & POSTER SESSION B	
16:00-16:30			
16:40-17:00			
17:00-17:20			
17:20-17:40			
17:40-18:00			
18:00-19:30			
19:30-20:30		DINNER	
20:30-24:00			

		Sept. 21, Friday Convention A	Sept. 21, Friday Convention B
		SC: K. Nakajima	
08:45-9:00			
09:00-9:30		**IS24: K. Kadowaki**	
09:30-10:00		**IS25: K. Endo**	
10:00-10:20		**CT50: B. Özçelik**	
10:20-10:40		**CT51: S. Rouhi**	
10:40-11:10		COFFEE BREAK	
11:10-11:40		SC: Anna Szerling	
		IS26: A. M. Samoylov	
11:40-12:10		**CT52: A. Nouri**	
12:10-12:30		**CT53: E. Tarhan**	
12:30-12:50		**CT54: M. Özdoğan**	
12:40-14:00		LUNCH	LUNCH
14:00-14:30		SC: K. Kosiel	SOCIAL PROGRAM
		IS28: A. Elarabi	
14:30-14:50		**CT55: H. Koseoglu**	
14:50-15:10		**CT56: S. Pekdemir**	
15:10-15:30		**CT57: Y. Alduran**	
15:30-15:50		**Concluding Remarks**	
15:50-16:00			
16:00-16:30			
16:40-17:00			
17:00-17:20			
17:20-17:40			
17:40-18:00			
18:00-19:30			
19:30-20:30			
20:30-24:00			

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POSTER SESSION A (3.30 pm to 5.40 pm, September 19, 2018)

PA01	**Kinetics of Deposition and Microstructure of PbTe Films Prepared on Si and BaF_2 Substrates by Modified HWE Technique** Alexander Samoylov
PA02	**Co-doped ZnO Thin Film Nanocomposites as Model Nanocatalysts** Asghar Ali
PA03	**Syntheses and Langmuir-Blodgett Thin Films of the Partly and Fully-Substituted Ferrocenyl Pendant-Armed Spirocyclotriphosphazenes** Nuran Asmafiliz
PA04	**Thin Films Electrical Conductivity Determination Using Ellipsometry** Boubekeur Bırouk
PA05	**The effect of Cu:ZnO and Mg:ZnO thin films deposit on porous ceramic for the structural, morphological and photocatalytic properties** Dikra Bouras
PA06	**SiN/SiO_2 Passivation Stack Of N-Type Silicon Surface: Comparison Between RTO and NAOS** El Amranı Abdelkader
PA07	**Hydrophilic modification of surfaces via plasma polymerization** Monika Stupavska
PA08	**Synthesis, characterization and application of electrochemical corrosion of phosphonate (ETPA)** Nabila Alıouane
PA09	**Microstructural, mechanical and tribological properties of TiAlN- (Ag,Cu) nanocomposite coatings deposited by DC magnetron sputtering for medical applications** Hernán Darío Mejia Vasquez
PA10	**Micro-supercapacitors from carbon films prepared onto nanowires silicone substrate** Nacera Rachedi
PA11	**Microstructure and electrochemical behaviour of alumina ceramic films developed on stainless steels used in the nuclear industry by electrolytic plasma processing** Victor Aurel Andrei
PA12	**Analysis by ellipsometry of porous silicon and AC impedance spectroscopic investigation of a-Si:H deposited on multilayered porous silicon** Hadj Yahia Seba

PA13	**Development of NiO_x and WO_3 Nanofilm Layers and Polymer Electrolyte for Electrochromic Devices** Jose Enrique Martinez Medina
PA14	**Three-layer model in optical characterization of randomly rough silicon surfaces covered with native oxide layers** Ivan Ohlidal
PA15	**Optical characterization of non-stoichiometric silicon nitride films exhibiting combination of several defects** Jiri Vohanka
PA16	**Electrodeposition and characterization of Ni-Cr composite coatings** Aidaoui Elkhanssa
PA17	**Preparation of iridium films using a new precursor [Ir(cod)Cp*] by MOCVD method** Dmitry Bonegardt
PA18	**Structural, morphological and photocatalytic properties of Fe doped TiO_2 thin layers** Fayçal Bensouici
PA19	**Growth Lithium Tetraborate $Li_2B_4O_7$ by Czochralski Method Study of Non-Linear Properties by Fourth Harmonic Generation** Hakem Amina
PA20	**Improved absorbance the mixed V_2O_5 / F_2O_3 / SiP structure** Cheraga Hocine
PA21	**YIG Film Grown on Quartz by Spin-Coating** **Ahmet Ekicibil**
PA22	**Sol-gel Processed Niobium-doped Titanium Dioxide as Alternative to Indium Tin Oxide in Transparent Conductive Coatings** Aseel Hassan
PA23	**Ab initio study of thermal properties of Zr-Fe system** Farouk Mebtouche
PA24	**Effect of deposition temperature and crystalline system of substrate on the characteristics of Titanium Nitride layer deposited by active Radio-Frequency (RF) magnetron sputtering** Bachir Messaid
PA25	**The Growth and Interface Analysis of Diamond on GaN** Jiwen Zhao
PA26	**Room Temperature Deposition of Homogeneous, Highly Transparent and Conductive In_2O_3 Films by Reactive High Power impulse Magnetron Sputtering** Shuai Gao

PA27	**Magnetron sputtered TiN thin films toward enhanced performance supercapacitor electrodes** Zhoucheng Wang
PA28	**A new p-type transparent Se doped La_2O_3 semiconductor film deposited by a novel two-step rf magnetron sputtering and selenide processs** Gang Gao
PA29	**Optical constants and structural properties of nanostructures with low dimensions** Petronela Garoi
PA30	**A comparative study of physical properties of ZnO thin films deposited by chemical spray using different amounts of ethanol and methanol in the starting solution** Dwıght Acosta
PA31	**Toward Controlling the Composition and Properties of SiOx Films by Atomic Layer Deposition** Hong-Liang Lu
PA32	**Influences of Gadolinium Doping on Microstructure and Optical Properties of Cadmium Oxide Thin Films by Reactive High Power Impulse Magnetron Sputtering** Lei Yang
PA33	**High Mobility and Transmittance of p-Type Copper Iodide Thin Film Fabricated via Solid Iodination Method Layer by Layer at Room-Temperature** Fangjuan Geng
PA34	**Characterization of PLA/PCL films and plasticized PLA/PCL films with plasticizers vegetable (TEC and PEG3)** Mounira Maiza
PA35	**Conductive Nanoparticle-Assisted Silver Nanowire Transparent Conductive Film Material** Dongchao Ji
PA36	**Synthesis and characterization of polypyrrole coated paper substrate and decorated with silver nanoparticles. Applicationin the electroreduction of nitrate.** Hamam Abderrazak
PA37	**Comparative Studies Between The Effect Of H2O and Methanol On The Growth Of Copper Oxide (CuO) Thin Films Deposited By Spray Pyrolysis** Serrar Hacene
PA38	**Study of Thin films of Nickel Oxide (NiO) Deposited by the Pyrolysis Spray Method** Bouhank Antar

PA39	**Atomic Layer Deposition and Infrared Transparency Properties of Sc2O3 Thin Films** Liangge Xu
PA40	**Study the relationship between the damage degree of ITO transparent conducting film and its electromagnetic shielding by Computer Simulation Technology (CST)software** Fei Xia
PA41	**Influence of the Physical Properties of SiNx Deposited Layer on PEEK Support on the Cellular Growth Capacity** Stefan-Luci Toma
PA42	**Low Temperature Plasma Assisted Regenerable Antimicrobial Structures on Textile Materials** Bengi Kutlu
PA43	**Selective etching of LT-GaAs in processing of THz AlGaAs/GaAs quantum cascade lasers** Anna Szerling
PA44	**Structural and Mechanical Properties of Mo2N/CrN Multilayers Deposited at 600°C by DC Magnetron Sputtering** B. Bouaouina1
PA45	**Roll-to-Roll Production of Layer-Controlled Molybdenum Disulfide: A Platform for 2D Semiconductor-Based Industrial Applications** Ki-Seok An
PA46	**The Effect of Deposition Parameters on the Wear and Scratch Properties of TiAlZrN Coatings** Yaşar Sert

POSTER SESSION B (3.30 pm to 5.40 pm, September 20, 2018)

PB01	**Optimization of the absorbent layer CISe deposited on the glass substrate by Spray pyrolysis** Bachir Messaid
PB02	**Determination of Ag-S interface of L-cysteine on silver surface** Kaveenga Koswattage
PB03	**Seed-Mediated Growth of Metallic Nanostructures on End-grafted Polymer Thin Films** Menekse Sakir
PB04	**Hydrothermal synthesis of $ZnCo_2O_4$ electrode material for supercapacitor applications** Fatma Nur Tuzluca
PB05	**Numerical Solution to KPZ Equation for Radial Interfaces** Roya Ebrahimi Viand
PB06	**CVD Graphene Contact Electrode for ZnO/Graphene based photodetectors** Gülçin Dönmez
PB07	**Mesoporous $NiCo_2S_4$ nanostructures grown on 3D graphene-nickel foam for supercapacitor applications** Yasar Ozkan Yesilbag
PB08	**Spectral Artificial Diamond Growth and Boron doped by HFCVD method to use in bits** Mostafa Dadashbaba
PB09	**Optical Characterizations of PVA/Porous SiC powder based Composite Thin Films** Rabea Rahmoune
PB10	**Study of interface induced structure and magnetic properties of Gd/Co multilayer films** Mulla Ahmad Basha
PB11	**Investigament of Atomic Force Microscopy and Optical Properties of Graphene Nanowalls (GNWs)** Ebru Senadim Tuzemen
PB12	**Fabrication of Silicon nanowire/Cu2O nano-heterojunctions by electroless deposition technique for photodegradation of methylene bleu in visible light** Bakri Rezika
PB13	**Investigation of Structural and Mechanical Properties of DLC Thin films in Reduction Atmosphere** Ranjan Kum Ghadai
PB14	**Influence of Oxygen Flow Rate on the Spraying of Aluminum Oxide (Al_2O_3) for Silicon Surface Passivation** Lyes Zougar

PB15	**Influence of substrate bias voltage of titanium oxynitride coatings deposited by PVD on the structure, composition and properties** Noureddine Madaoui
PB16	**The Effect of Dislocation Density on the Penetration of Au from the Metal Contact into GaN** Adam Barcz
PB17	**Preparation, growth, microstructure and optical properties of nonvacuum Cu/Co co-doped ZnO thin films** Lutfi Arda
PB18	**Ion Implantation Several-µm-Deep Electrical Isolation in AlGaAs/GaAs Quantum Cascade Lasers** Maciej Kozubal
PB19	**Design, fabrication and characterization of high voltage AlGaN/GaN-on-Si HEMTs with various field-plate structures** Andrzej Taube
PB20	**Growth and Characterization of ZnO Nanostructures on Porous Silicon Substrates: Effect of Current Density** Gulsah Aydemir
PB21	**Effect of Deposition Pressure and Power on the Perpendicular Magnetic Anisotropy in Hf/CoFeB/MgO Multilayer Structure** Mustafa Akyol
PB22	**The thickness and temperature dependence of ZnO thin films on Si (100) substrate deposited by thermal evaporation** Gokhan Utlu
PB23	**Thermal Transport Properties of 2-D Graphene with Carbon Chain** Koray Sevim
PB24	**Compressive mechanical properties of nickel nanowires coupling of the pre-oxide shell layer and the size** Gurcan Aral
PB25	**Effect of bias voltage on structure, morphology and hardness of ZrN coating deposited by reactive magnetron sputtering** Reza Madanypoor
PB26	**The Effects of Annealing in Air, Argon and Selenium on Optical Properties of $CuGa_{0.3}In_{0.7}Se_2$ Thin Films** Abdesselam Bouloufa
PB27	**Aluminum-doped hydrogenated amorphous silicon carbon (a-SiC:H(Al)) by co-pulverization DC magnetron** Brıghet Amer
PB28	**XPS Analysis of Chemical Vapor Deposition Growth of Graphene from Ethanol** Ranjeet Brajpurıya
PB29	**ITO Coated Touch Sensing Screen** Ugur Mert Ulutanır
PB30	**Fabrication and Characterization of Magnetron sputtered ITO /Au/ ITO Thin Film Filters** Bengu Ata

PB31	**Growth of High Quality ITO Thin Films by DC Magnetron Sputtering on Large Area** Zemzem Uyanık
PB32	**Increasing the Visible Light Photocatalytic Activity of ZnO_x Layers by Doping with Nitrogen** Stefan-Luci Toma
PB33	**ZTO/Ag/ZTO Thin Films Fabricated on PET Substrates for Large Area Flexible OLEDs** Merve Ekmekcioglu
PB34	**Thermal numerical analysis of crucible induction heating in a crystal pulling (CZ) furnace** Djamel Ouadjaout
PB35	**Structural and Magnetic Properties of $(Ni80Fe20)_x/Cu_{(1-x)}$ Alloy Thin Films** Yasin Akbas
PB36	**Hydrothermal-Electrochemical Deposition of Semiconductor Thin Films for Solar Energy Harvesting** Ceren Yılmaz Akkaya
PB37	**Synthesis of $Cu_2ZnSnSe_4$ Bulk Crystal for Solar Cells Application** Safia Kerour
PB38	**ITO Large Scale Thin Film Deposition on Flexible PET Substrates for Solar Cell Applications** Yasemin Demirhan
PB39	**Layer-by-Layer System for 2D Materials** Özge Kocahan
PB40	**Transparent conducting films of Nb and F codoped tin oxide** A. I. Martinez
PB41	**Plasma Characteristics Aiding the Enhancement of Surface-Modified-Polyethylene** Dogan Mansuroglu
PB42	**Synthesis and Characterization of TiO_2 Coatings Achieved by a High Power Atmospheric Pressure Axial Injection Plasma Torch** Dogan Mansuroglu
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IS01

Possible Applications of Thin $Bi_2Sr_2CaCu_2O_{8+\delta}$ Film for Terahertz Wave Oscillator and Detector

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[keywords] Intrinsic Josephson Junctions, terahertz waves.

$Bi_2Sr_2CaCu_2O_{8+\delta}$ (Bi-2212) *high-*T_C superconductor manifests a significant diversity in terms of possible terahertz (THz) wave application. For instance, the ac Josephson effect of intrinsic Josephson junction [1] of Bi-2212 single crystal, enables us to generate weak THz oscilation [2]. It has been reported that number of intrinsic Josephson junctions can be synchronized and emit powerful THz wave [3] by establishing a THz cavity structure so-called "Mesa" on Bi-2212 single crystals. For THz oscillation purpose, we have succeeded to reproduce powerful THz emission from intrinsic Josephson junction made of solid Bi-2212 film grown on MgO substrates at operating temperatures higher than that reported earlier using "Mesa" devices made of bulky single crystal. However, we suffered by considerable number of THz inactive devices although these devices indicate no remarkable differences in their own junction *I-V* properties. In this presentation, we present our recent work [4] for RF isolation effect to invoke THz radiation even from those THz inactive devices as fabricated at first.

For detector purpose, we have been studying fabrication of ultra-thin Bi-02212 films on dielectric substrates suitable for THz bolometer. At first, we have succeeded epitaxial growth of few nm thick Bi-2212 film by Metal Organic Decomposition (MOD) method on $SrTiO_3$ (STO) 100 substrates with good crystallinity and superconductivity. However, we measured poor THz optical properties for STO due to dielectric loss. Therefore, we looked for dielectric substrates alternative of STO for epitaxial growth and found $NdGaO_3$ for a good substrate candidate. The crystal structure of NdGaO3 is orthorhombic and the 001 plane (a = 0.543 nm, b = 0.550 nm) exhibits epitaxial fitting relation for the 001 plane of Bi-2201 (a = 0.540 nm, b = 0.539 nm) better than STO (001). Details of MOD deposition, crystallinity and superconductivity will be presented.

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IS02

Metal-metal waveguides for AlGaAs/GaAs terahertz quantum cascade lasers: the role of different metals and technological issues

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[keywords]: THz quantum cascade lasers, AlGaAs/GaAs, metal – metal waveguides, waveguide losses, gold, silver, copper, diffusion-barrier layers, wafer bonding

Gold, silver and copper as cladding layers in metal–metal waveguides were studied for application in AlGaAs/GaAs terahertz quantum cascade lasers (THz QCLs). The possibility of improvement of such waveguides by decreasing their losses and enhancing their thermal stability was primarily considered. By theoretical analysis of waveguides losses that were calculated for metal-metal waveguides based on different metals, it was found that at least ±10 % accuracy of theoretically foreseen refractive index value is required [1] to enable such optimization.

In this work both theoretical predictions and the results of experimental work on different metal-cladding waveguides will be presented. The focus will be put on technological conditions that suppress the diffusion process of metallic components in the semiconductor active region of the QCLs in order to significantly reduce the risk of damage of the laser active region by unintentional migration of metals. The next important issue which will be presented widely will be the *ex-situ* and *in-situ* wafer bonding of the active region of QCls and receptors. We will compare the results for these two types of bonding technology.

Our studies showed that it was necessary to apply at least 5nm-thick diffusion-barrier (titanium) layers, as well as to keep all of the process temperatures below 400°C. The next important issue was to apply technological solutions which allow to control the composition of metallic claddings, in order to provide the control of the refractive index profiles of the claddings.

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IS03

p-type and n-type Dye Sensitized Solar Cells

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[keywords] n type ZnO nanomaterial, p-type nanomaterials, dye solar cells.

Dye sensitized solar cells have been studied as a low cost solar energy platform for more than two decades. The most well developed dye sensitized solar cell devices are n-type semiconductor and n type TiO2 as a mesoporous photoanode [1]. In this typical configuration the TiO2 surface is functionalized with molecular photosensitizer that inject electrons into the material and the oxidized photosensitizer is regenerated by a liquid electrolyte. More recently, dye sensitized photoelectrosynthesis cells have been developed and used with the same configuration to produce solar fuels [2]. After succeeding TiO2 and ZnO based DSSCs and solar fuel generation, future challenge is based on tandem devices which require photoanode and photocathode electrodes [3].

p-type dye sensitized solar cells are new concept and require p-type electrode material. However, initial efforts to create these p-type dye sensitized solar cells have concluded low performances. The important strategy in this type of cell is to design novel p-type molecular material and to synthesize novel p-type material which show suitable EHomo level for electron injection from p-type metaloxide layer. In this concept, we have rationally designed and synthesized novel n-type and p-type materials.

Here, we present a first step toward developing new, more efficient morphologies for NiO and designing thin films that can be used in p-type dye sensitized solar cells and tandem dye sensitized solar cells. NiO thin films are characterized XRD, XPS, EDS and SEM images. Also ZnO photoanode electrodes are synthesized for n-type device characterizations. Dye sensitized solar cells are characterized J-V, EQE and impedance measurements. Our unpublished results show that this new strategy is higly promising to increase efficiency and it opens new concept for pn Tandem dye sensitized solar cells.

*This research is partially supported by TUBITAK (Scientific and Technical Research Council of Turkey) project number 114F161. S.E.E acknowledges support from Turkish Academy of Sciences and Alexander von Humboldt Foundation.

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IS04

Spin-Orbit Torque Driven Magnetization Switching in Metal-based Multilayer Structures

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[keywords] Spin-Orbit Torque, Spintronic, Magnetic Tunnel Junction, MRAM.

Manipulation of ultra-thin perpendicularly magnetized layer through electric current-induced spin-orbit torques (SOTs) has raised considerable interest due to its promising applications in magnetic random access memory (MRAM) and magnetic logic devices [1,2]. The magnetization can be controlled by electric current flowing inside the heavy metal layer which can generate transverse spin-currents flowing into the ferromagnetic layer, which results in SOTs on the magnetization of ferromagnetic layer. However, pure electric current cannot fully switch the perpendicularly magnetized ultra-thin layer in heavy-metal/ferromagnetic/insulator multilayer structure [3]. Thus, a magnetic field along current is required to assist SOTs to realize deterministic switching of perpendicular magnetization. Recently, we are working on how the role of required in-plane magnetic field can be replaced by breaking structural symmetry. The experimental results showed that current-driven perpendicular magnetization switching without external magnetic field is possible in such structures, when they exhibit structural asymmetry along the in-plane direction, in addition to the symmetry breaking along the *z*-direction of the structure. Spintronic experiments were performed in micron-scale Hall-bar devices in heavy-metal (Ta, Hf)/CoFeB(wedge)/insulator multilayer structure which is used in Magnetic Tunnel Junction (MTJ) as a free part. In addition to the *z*-axis symmetry breaking, the lateral structural asymmetry gives rise to a new field-like SOT when in-plane electric current flows in the device. This new out-of-plane SOT can mediate to switch of perpendicularly magnetized ultra-thin ferromagnetic layer in such structure. In summary, pure electric current can be transverse to spin-current to manipulate the magnetization by breaking symmetry in both z- and lateral symmetry. In the presentation, I will discuss recent works on electric current-driven SOT phenomena in metal-based multilayer structure without assistance of fields.

*I would like to acknowledge and thank all those who are working in Materials Research Group in Çukurova University, Turkey and Device Research Laboratory in University of California, Los Angeles (UCLA), USA.

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IS05

Terahertz Diffuse Scattering from Coding Metasurfaces

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[keywords] metasurfaces, diffuse scattering, terahertz waves.

In the last few years, the concept of metasurfaces, two-dimensional thin-film planar structures composed of sub-wavelength building blocks, have become the new paradigm in the physics of metamaterials, opening up researchers imagination for the realization of a new generation of flat optical elements with unique functionalities. Metasurfaces retain the great capabilities of their three dimensional counterparts in the control of electromagnetic waves while reducing the fabrication challenges. By judiciously engineering the parameters of the "unit cells" like geometry, size, material, and selecting specific design algorithms, metasurfaces promise to revolutionize the field of photonics and plasmonics. A recently presented approach for the manipulation of electromagnetic waves is based on coding metasurfaces consisting of "digital" cells [1]. Here we present time domain measurements to investigate the relevant scaling-laws and the physical mechanism underlying the scattering-signature reduction observed in coding metasurfaces operating at 1 THz and based on two basic unit cells with out-of-phase responses. Digital metasurfaces covering an area of 1 cm^2 are designed based on the Golay-Rudin-Shapiro polynomial code [2] and fabricated using a UV photolithographic method. Two 200-nm thick gold films interposed by a polyamide layer are deposited by spin coating and the final pattern is formed by lift-off procedure. For the experimental investigation of the metasurfaces under test we use a customized fiber-coupled spectrometer with photoconductive antennas both for THz emission and detection. Applying different detection and collection schemes for the specular and angular reflections we are able to extract the attainable radar-cross-sections as a function of angle and frequency for different coding [3]. Experimental results are corroborated by rigorous full-wave numerical simulations and may be of interest in a variety of application fields, such as the design of low-scattering targets and illumination apertures for computational imaging, not necessarily restricted to electromagnetic scenarios.

*This research is partially supported by INFN (National Institute for Nuclear Physics) under the project "TERA".

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IS06

Nanoscale order and femtosecond dynamics of correlated electron states in layered dichalcogenides

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[keywords] transition metal dichalcogenides, charge density wave, superconductivity, transient reflectivity, scanning tunneling microscopy

Transition metal dichalcogenides have relatively simple crystal structure, but, on the other hand, harbor an eloquent number of correlated electron phenomena such as superconductivity, charge density wave, magnetism and exciton condensate. $TiSe_2$ is a member of transition metal dichalcogenide family of layered van der Waals materials that has attracted significant interest due to the intricate mechanism that drives its transition from a semiconducting to a charge density wave (CDW) phase. Intercalation of $TiSe_2$ with copper donates electrons to the conduction band near the Fermi surface, producing a metallic phase at room temperature and a superconducting phase at low temperatures. The relationships between these phases are nontrivial, especially considering that both the CDW and superconductivity rely on specific electronic and electron-phonon interactions.

We investigate both transient optical response and atomically resolved scanning tunneling microscopy and spectroscopy of electronic states in Cu_xTiSe_2as a function of temperature and copper doping from x=0 (semimetal and commensurate charge density wave phases) to x=0.08 (metallic and superconducting phases). We find that the cooperative driving mechanisms for the CDW, the excitonic insulator mechanism and the soft L_1^- phonon mode, decouple at x=0.04, where fluctuations of a quantum critical point were observed in the folded Se-4p band. We also demonstrate a loss of coherence in the A_{1g} phonon signal with increased copper intercalation of the parent lattice, indicating a loss of long-range lattice order. These findings provide compelling evidence that $TiSe_2$ undergoes a quantum phase transition upon Cu intercalation from a state of commensurate charge order without superconductivity to a state with a different symmetry in which new charge order coexists with the superconducting phase [1]. Superconductivity in $TiSe_2$ is very intriguing by itself as it appears with copper or palladium intercalation or under pressure in the intrinsic system. We will discuss the results obtained in Cu_xTiSe_2 system and the conclusions drawn from complex set of local STM/STS and bulk thermodynamic measurements on single.

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IS07

Development of novel hybrid organic solar cells with improved device efficiency

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P3HT:PCBM bulk heterojunction-based organic solar cells have been extensively studied as an excellent organic light absorbing layer for applications in organic solar cells. Such devices have suffered from low efficiencies as well as low active layer stability. This unsatisfactory performance of P3HT:PCBM-based OSCs was mainly ascribed to low charge carrier mobility and short diffusion length of generated excitons. Extensive research has been carried out in order to overcome these difficulties and thus improve device stability and efficiency. These included improvement of device processing using different solvents [1], increase the charge collection properties by insertion of additional layers at the interface between the anode and/or cathode to improve charge collection properties [2]. In the current study novel composite organic solar cells are produced by blending zinc (II) phthalocyanine (ZnPc) with poly (3-hexylthiophene-2,5-diyl) (P3HT). We demonstrate here two different strategies to incorporate peripherally substituted ZnPc with its excellent light absorbing properties in the P3HT:PCBM-based solar cells in order to enhance light harvesting properties of the solar cell. Symmetrically octasubstituted ZnPc bearing eight polyoxyethylene groups (ZnPc-0py) and asymmetrically substituted ZnPc bearing one pyrene and six polyoxyethylene groups (ZnPc-1py) as substituents have been synthesised and studied for this purpose. P3HT:ZnPc-0py and P3HT:ZnPc-1py hybrids as sensitizer layers are inserted between the P3HT:PCBM active layer and PEDOT:PSS. This interfacial substitution approach has resulted in a decrease in the PCE of the OSC compared to the reference device. The two ZnPc derivatives were then applied as a component in ternary blends within the P3HT:PCBM. The PV characteristics of the investigated devices have revealed Optimum performance the P3HT:PCBM:ZnPc-1py hybrid with power conversion efficiency (PCE) as high as 3%, however, both types of substitution have exhibited better device performance compared to the pristine P3HT:PCBM-based solar cell structure. Results are discussed in full length and remarks are made regarding the viability of the current device processing approach.

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IS08

Tailoring of Skyrmion Behavior via Interlayer Exchange Coupled Magnetic Thin Films

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[keywords] Skyrmions, Magnetic thin films, Dzyaloshinskii Moriya Interaction

Magnetic skyrmions, which were theoretically proposed by Tony Skyrme in 1962, are micron or sub-micron sized vortex-like quasiparticles present in magnetic materials having strong Dzyaloshinskii-Moriya interactions (DMI) [1]. Skyrmions have attracted a great deal of interest over the years due to the potential and diversity of skyrmionic devices, in which the skyrmions can be fundamentally used as the information carrier in the next-generation logic and memory devices due to its remarkable magnetic stability, extremely compact size and very-low-cost driving force within the nanostructure.

We propose a novel approach to control and manipulate the skyrmion size in coupled magnetic thin film stacks consist of two ferromagnetic layers; whose magnetic easy axis are perpendicular to each other in the case of layers are uncoupled or weakly coupled [2]. [Pt/Co]2 and Co layers seperated by a non-magnetic spacer are used, which allows a long-range Ruderman-Kittel-KasuyaYosida (RKKY) interaction between the layers [3]. In this study, the formation of magnetic skyrmions in the film stacks is studied by micromagnetic simulations. The numerical solution of the LandauLifshitz-Gilbert equation comprising the precession term and the damping term is employed to construct our model. The size of skyrmions appearing in the thicker single layer of Co can be controlled by the external magnetic field as well as the strength and sign of the internal field arising from the RKKY coupling. The skyrmion radius is found to be dependent on the z-component of magnetization of the layers, which can be tailored by the RKKY coupling. Furthermore, in the absence of magnetic field, the skyrmion phase coexists with the helical phase. The interaction also enables to control the size of the zero field skyrmions. We anticipate that our study not only offers further insight into the rationalizing skyrmion size but also will inspire future discussions.

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IS09

Towards functionalised surfaces through atomistic understanding and chemical design

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[keywords] nanoarchitectonics, surface coordination networks, scanning tunnelling microscopy.

Organic species and nanoarchitectures including metal atoms at well-defined interfaces provide high potential for key technological applications, spanning over the design of single-site heterogeneous catalysts, novel materials for light harvesting, the fabrication of molecular rotors and nanomachines and the advent of molecular spintronics. The advancement is underpinned by the continuous development of materials with tailored properties controllable at the molecular scale. Thus, it is of central importance to explore new strategies for synthesis and processing, which should ideally minimize costs and effort and be clean, reproducible and highly controlled.

Here we visit the extension of the conjugation (polymerisation) of all-organic N-containing molecules with the aim of tuning the electronic bandgap [1]. Further functionalisation is achieved by incorporation of various metals in the surface nanoarchitectures [2]. In reverse order, we investigate new avenues towards metal directed self-assembly of organic matter at interfaces, by adjusting the functional moiety of the organic part, or the metal centre [3]. Finally, we extend this approach to introduce organometallic nanostructures with carbenes [4], which provide strong tethers to surfaces, routes to organometallic materials, metallopharmaceuticals and homogeneous catalysts. We achieve both planar and out-of-plane ligation, therefore giving the potential for extension from surface supported two-dimensional to thin films of metal-organic frameworks.

Our methodology encompasses a battery of cutting-edge experimental techniques developed for ultrahigh vacuum surface science: scanning probe microscopies address single molecule behaviour, while photoelectron spectroscopy allows to scrutinize molecular ensembles. The integration of various analysis techniques combined with theoretical studies generates a high degree of precision in the understanding of interfacial processes at the atomic level. Henceforth the structure function relationships may be deciphered enabling innovative pathways for the bottom-up fabrication of advanced, functional nanoarchitectures.

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IS10

Surface-plasmon optical soliton photonic Josephson junction

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[keywords] surface plasmons, optical solitons, bosonic Josephson junction.

An evanescently coupled, co-propagating optical soliton and a surface plasmon can exhibit bosonic Josephson junction dynamics similar to that of Bose-Einstein condensates in double-well traps.[1, 2] Moreover, the self-focusing of the soliton generates an inherently intensity (photon population) dependent coupling, which exhibit unique dynamical features. Here, we review our study on the dynamical properties of this photonic Josephson junction based on a heuristic model and discuss recent extensions involving plasmon-soliton-plasmon double Josephson junctions and Rosen-Zener like transitions generated by spatially modified coupling.[3, 4] With the advancement of photonic materials, realization of this optical system may enable new abilities to control and utilize the propagation of light.

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IS11

Molecular nanosystems at interfaces

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[keywords] supramolecular assembly, complex tesselations and networks, on-surface synthesis, functional interfaces, nanoscale science and engineering.

The utilization and organization of molecular species is an important issue for advancing nanoscale science and underpins the development of novel functional materials. To this end we explore molecular bonding and assembly at well-defined homogenous surfaces, textured templates, nanoelectrodes and 2D-sheet layers. The developed bottom-up fabrication protocols employ tailored building blocks and exploit both supramolecular engineering and on-surface covalent synthesis. Structure formation, chemical conversions, electronic and other characteristics are addressed by a multitechnique experimental approach, whereby scanning probe microscopy provides molecular-level insights that are frequently rationalised with the help of computational modeling. We work toward a rationale for the control of single molecular units and the design of nanoarchitectures with distinct functional properties.

IS12

Oxide nanosheet photocatalysts for water splitting

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[keywords] pn-junction, hydrogen, co-catalyst, exfoliation.

Two-dimensional nanocrystals (nanosheets), prepared by the exfoliation of layered compounds, have atomically flat surfaces and homogeneous thickness, and are each a single crystal. Many types of nanosheets have been reported, such as graphene, oxides, hydroxides, and sulfides. It is expected that exfoliation of the layered compound to produce nanosheets could provide new functionalities and properties that the parent layered compound does not have. For example, graphene has unique properties that exceed those of graphite; the electrical conductivity of graphene is much higher than that of graphite due to occurrence of quasiparticles. The present paper introduces two types of nanosheets. One is emitting nanosheets [1-3], and the other one is Rh-doped oxide nanosheet with photocatalytic activity for water splitting [4-5]. The nanosheet prepared by exfoliating a layered compound ($Bi_2SrTa_2O_9$) shows blue emission, while the parent layered compound exhibits no blue emission. The Rh-doped $Ca_2Nb_3O_{10}$ nanosheet exhibits much higher photocatalytic activity without co-catalyst loading than its parent layered compound (Rh-doped $KCa_2Nb_3O_{10}$). These characteristic properties are due to the change in the structural dimension from 3D to 2D. Furthermore, these nanosheet materials are expected to be used as nano-building blocks for the preparation of nano devices that are difficult to prepare by conventional methods. For example, the preparation of ultrathin p-n junction with a thickness of around 1-2 nm from two materials with a large lattice mismatch by chemical vapor deposition (CVD) is generally difficult, in that crystal lattice strain or a decrease in crystallinity is generated in the vicinity of the interface. However, such p-n junction structure without an amorphous layer between different p-type and n-type semiconducting materials with different crystal phases can be prepared by lamination of p-type and n-type semiconducting nanosheets. This paper describes preparation of an ultrathin hetero pn-junction with a thickness of 2 nm or less using nanosheets, and the charge separation of photo-excited electrons and holes by the potential gradient formed in the ultrathin pn-junction [6].

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IS13

Semiconductor-to-metal transition in vanadium dioxide based thin films: from solar energy to microelectronics

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[keywords] germanium doped vanadium dioxide, phase-change tunnel field-effect transistor, gated MoS_2/VO_2 heterojunctions, coplanar waveguide bandstop filters.

At 68°C, pure VO_2 films undergo a fast and reversible semiconductor-to-metal transition (SMT). The transition temperature can be increased up to 95°C by Ge doping, while the hysteresis width and resistivity contrast are gradually decreased [1]. These findings make the use of vanadium dioxide thin films in solar and electronic device applications - where higher critical temperatures than 68°C of pristine VO_2 are needed - a viable and promising solution. A large variety of VO_2 based microelectronics devices have been studied recently.

A new principle has been proposed and validated in coplanar waveguide (CPW) bandstop filter tuning [2]. The tunable filter is fabricated on a high-resistivity silicon substrate based on a CMOS compatible technology using a 1 μm x 10 μm long and 300 nm thick vanadium dioxide (VO_2) switch by exploiting its insulator to metal transition. The filter is designed to work in Ka band with tunable central frequencies ranging from 28.2 GHz to 35 GHz.

A phase-change tunnel field-effect transistor (PC-TFET) has been proposed as a hybrid design integration of a tunnel FET and a 2-terminal SMT switch. Combining the strengths of the two devices results in the first solid-state VO_2-based 3-terminal switch with simultaneous very low I_{OFF} current, high I_{ON}/I_{OFF} ratio and ultra-steep subthreshold swing, a performance that cannot be individually achieved by a tunnel field-effect transistor or a MIT switch [3].

With the advent of 2D materials, thin van der Waals (vdW) heterostructures can be made based on a large diversity of materials. The vdW MoS_2/VO_2 heterojunction combines the excellent blocking capability of an n-n junction with a high conductivity in on-state, and it can be turned into a Schottky rectifier at high applied voltage or at raised temperature [4]. Furthermore, a tunable photosensitivity and excellent junction photoresponse in the 500/650 nm wavelength range have been obtained. For the first time, a field-effect transistor has been obtained from gated MoS_2/VO_2 heterojunctions. The electrostatic doping effect of the gate on the junction results in a subthreshold slope (SS) of 130 mV/dec at room temperature, $I_{ON}/I_{OFF} > 10^3$ and $I_{OFF} < 5$ pA/μm at V_D=1.5V.

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IS14

Metal phthalocyanine films and phthalocyanine-based hybrid structures as active layers of chemiresistive sensors

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[keywords] metal phthalocyanines, thin films, chemical sensors.

Thin films of metal phthalocyanine (MPc) derivatives and their hybrid materials are of considerable interest as active layers of chemiresistive sensors for different gases, viz. ammonia and hydrogen [1, 2]. Introduction of various substituents into the phthalocyanine macrocycle can significantly alter thin films structure and morphology and in its turn leads to the change of their electrical and sensing properties. Fluorine substituents decrease the electron density of the aromatic ring and increase the oxidation potential of the MPc molecule [3]. As a result, fluorosubstituted phthalocyanines ($MPcF_x$) exhibit the higher sensor response to such reducing gases as ammonia and hydrogen compared to that of their unsubstituted analogues [1, 2].

In this work, we prepare and study the structural features and sensor response to ammonia and hydrogen of thin films of $MPcF_x$ (M=Co, Zn, Pb, VO; x=0, 4, 16) and bilayered structures in which Pd layer is deposited by a Metal-Organic Chemical Vapor Deposition technique on the surface of $MPcF_x$ films.

It was shown that thin films of tetrafluorosubstituted phthalocyanine ($MPcF_4$) can be used as promising active layers of chemiresistive sensors for selective detection of low concentrations of ammonia (0.1-50 ppm) in the presence of CO_2 and water vapors. The bilayered structures $MPcF_x$/Pd exhibit a selective response to hydrogen. The dependence of the sensor response on the thickness of Pd layer is analyzed. It is demonstrated that the resistive sensors on the basis of such bilayered structures possess improved characteristics which are caused by synergistic effect based on combination of practically important properties of Pd-containing membranes (selectivity to hydrogen adsorption, high conductivity), and metal phthalocyanines (sensitivity of the electrical parameters to various interactions).

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IS15

Properties of FeSeTe Thin Films Grown by DC Magnetron Sputtering

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[keywords] DC Magnetron Sputtering, FeSeTe superconducting thin films

After discovering Fe-based superconducting systems, intensive efforts have been made to improve their properties. Various additions/substitutions, pressure effect, thin film or cable / strip form have been extensively studied over the last 5 years. Especially for thin film FeSeTe materials much better superconducting performance is obtained, compared to the bulk form, and the Tc exceeds 50 ° K in these samples. However, the biggest obstacle is the critical current density, Jc, which is focused on. It is still lower than that of the HTS materials. In this work, we report the fabrication of FeSeTe superconducting thin films by DC magnetron sputtering and the superconducting properties as a function of growth parameters of films on SrTiO3 (100), which are single crystal substrates without any buffer layer. The physical, electrical, magnetic and transport properties of the films produced were examined. The thickness of the films varied between 400-675 nm and the Tc of the films varied between 22 - 28 K. However the main goal is in the critical current density measurements, we achieved 4 M $A.cm^{-2}$ at 4.2 K and under 5 T of magnetic field.

IS16

Superconducting FeSe film made by electrochemical deposition

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[keywords] new, superconductivity, Thin film, iron.

FeSe films were electrochemically deposited on rolling-assisted biaxially textured substrate (RABiTS) tape and, we observed zero resistivity in the as-electrodeposited film without annealing. We investigated the influence of dipping time in a reaction solution before applying voltages. When the RABiTS tape was dipped in the solution, a thin Se film formed on the substrate before voltage was applied, and then the FeSe film was deposited on the tape by applying voltage. The compositional ratio of the FeSe film deviated from the stoichiometric ratio as the dipping time increased before applying voltage. We observed zero resistivity in the as-electrodeposited FeSe film prepared on the substrate when it was dipped into the solution while applying voltage.[1-6]

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IS17

Transparent conducting films of graphene oxide prepared by sputtering

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[keywords] Transparent conducting materials; graphene oxide; solar cells.

Inorganic oxides or carbon-based transparent conducting films (TCF) are materials of great scientific and technological interest [1, 2]. Graphene oxide (GO) films could be a good material for the development of TCF. GO films were deposited by RF magnetron sputtering at 400 °C, using a deposition pressure of 1.5×10^{-1} Torr in an argon atmosphere. The substrates were iron oxide (IO) films of 10 nm on glass or silicon wafers and graphite targets (99.99%). After deposition, the samples were annealed in vacuum at 600 ° C for 10 min. By Raman spectroscopy, it was proved that the as-deposited films exhibit the characteristic modes of GO, and after annealing the structural defects of GO are reduced. Atomic force microscopy (AFM) measurements revealed that the roughness of the samples is reduced after the deposition of GO films. Also, the morphology changes from a round shaped surface corresponding to the IO-films to the formation of flakes of GO. Moreover, the transmission measurements revealed the formation of transparent GO films with an electrical resistivity of 16-20 kOhm/□, without an important role of annealing on the electrical properties. The nanohardness measurements revealed that the annealing does not modify the hardness of the GO. Additionally, the deposition of GO films has been deposited on the top of silicon solar cells. The role of sputtered GO films on the I-V characteristics of solar cells will be discussed.

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IS18

Optical Properties of Silicon Nanocrystals in SiO_2 Matrix Synthesized by Reactive Pulsed Laser Deposition t Results

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[keywords] Silicon, Nanocrystals, Photoluminescence, PLD, Excimer-UV, RTA

After first reports on room temperature visible photoluminescence (PL) in the early 1990s [1], 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 [2]. 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. The PL arising from implanted Si nanocrystals in SiO_2 has been attributed by some investigations to simple quantum confinement, while others have concluded that surface states present in the interfacial layer (including some types of defects) between the Si nanocrystals and the surrounding oxide matrix (localized surface states) play an important role in the emission process.

In this work, we report the optical properties of Si nanocrystals embedded in a SiO_2 synthesized by reactive pulsed laser deposition (PLD) in an oxygen atmosphere. Si sub-oxide (SiO_x, $0<x<2$) films were firstly deposited on Si wafers, by suing conventional PLD system with 2nd-harmonic YAG laser (532nm, 10Hz) under controlled low oxygen pressure. After deposition in the oxygen ambient, the produced SiO_x films were annealed using a conventional tube furnace (FA) for several hours at 1050 ^oC in N_2 atmosphere to induce the formation of Si nanocrystals, by decomposition of the SiO_x phase and aggregation. Some of the samples were irradiated with excimer-UV light (172 nm, 7.2 eV, Xe_2^*) for 2 hours with power density of 50 mW/cm^2 in vacuum or rapidly thermal annealed (RTA) at 1050 ^oC in N_2 atmosphere for 5 minutes with a rising rate of 50 ^oC/sec before FA. Conventional room temperature PL spectra were measured at various stages of the processing. A He-Cd laser (325 nm, 3.82 eV) was used as the excitation source and the luminescence was detected by a cooled photomultiplier tube, employing the photon counting technique.

We found that the luminescence intensity is strongly enhanced with UV irradiation and RTA. Based on our experimental results, we discuss the effects of excimer-UV lamp irradiation and RTA process on the formation of Si nanocrystals. In case for PLD produced samples, PL intensity increases with increasing oxygen gas pressure, and then decrease. We also found that the maximum intensity can be obtained with oxygen pressure around 0.6Pa. It is also noted that the peak energies of the PL are affected by ambient oxygen pressure. In some cases blue-shift, other cases red-shift. The formation process of luminescent Si nanocrystals with UV, RTA and FA treatments can be explained with bond-breaking (Si-Si and/or Si-O), defect generation, de-nucleation, defect-initiated nucleation and frozen of individual states.

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IS19

Optical Bio-sensing Technologies for Detection of Mycotoxins

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[keywords] optical biosensors, mycotoxins, gold nanostructures, LSPR, TIRE, planar waveguides

This work, which was supported by NATO Science for Peace and Security research project NUKR.SFPP 984637, focuses on the development of novel optical bio-sensors for detection of mycotoxins. Mycotoxins are common contaminants in agriculture products (grains, nuts, coffee beans, spices, fruits, etc.) and associated food and animal feed which appeared there as products of metabolism of various fungi species. Because of high toxicity, carcinogenic, and endocrine disrupting properties, mycotoxins attracted great deal of attention from environmental agencies and health organizations worldwide. In addition to traditional analytical high-tech methods for mycotoxin detection, the development of low cost, portable, though highly sensitive biosensors suitable for in-field and point-of-care diagnostics is in great demand nowadays.

Several optical transducing techniques, such as total internal reflection ellipsometry (TIRE), localized surface plasmon resonance (LSPR), and polarization interferometry (PI) were explored in this project. The detection of several mycotoxins (aflatoxin B1, zearalenone, ochractoxin A) was carried out in the immunoassay with specific antibodies which were immobilized on the surface either electrostatically or covalently. Aptamers were also used as an alternative to traditional antibodies. A combination of TIRE and LSPR methods allows the detection of mycotoxins in 0.01 ppb range of concentrations in direct assays with either split antibodies or aptamers. Future development of portable biosensor devices suitable for in-field detection of mycotoxins lies in the use of planar waveguides. In the current project, we developed a planar waveguide sensor prototype operating as polarization interferometer which is capable of detecting mycotoxins in sub-ppt level of concentrations in direct immunoassay format.

IS20

Next Generation Photovoltaic Thin Films

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[keywords] Thin film photovoltaics, solar cells, pulsed laser deposition.

In this talk, recent developments on the next generation thin film photovoltaic materials will be presented. The talk will be focused in three main subjects in this field: 1-) Recent advances in Pulsed laser deposited CdTe/CdS thin film solar cells and CdTe/CdSe based windowless solar cells using photocurrent scanning microscopy 2-) Inorganic thin films solar cells with conducting polymer coating as the contacts 3-) Metal nanoparticle enhancement on the photovoltaic conversion efficiency on the thin films solar cells. For the first part we will present our work on windowless solar cells where, CdS(Se) is electrodeposited on one electrode, and CdTe is deposited by pulsed laser deposition over the entire surface of the resulting structure. Previous studies of symmetric devices are extended in this study. Specifically, device performance is explored with asymmetric devices having fixed CdTe contact width and a range of CdS(Se) contact widths, the devices also fabricated with improved dimensional tolerance. Scanning photocurrent microscopy (aka, laser beam induced current mapping) is used to examine local current collection efficiency, providing information on the spatial variation of performance that complements current-voltage and external quantum efficiency measurements of overall device performance. Modeling of carrier transport and recombination indicates consistency of experimental results for local and blanket illumination. Performance under simulated air mass 1.5 illumination exceeds 5% for all dimensions examined with the best performing device achieving 5.9 % efficiency. The second part will concentrate on our studies of using conducting polymers as the solar cell contacts instead of conventional metal contacts. We will discuss the effects of the reducing the Schottky resistance barrier at the interface by using conducting polymers. In the final part, we will present our work on the inclusion of metal (Ag, Au) nanoparticles on the inorganic thin film solar cells and plasmonic resonance effects due to metal nanoparticles on increasing the photovoltaic conversion efficiency in these devices.

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IS21

Metal films by Laser Ablation Backwriting on Glass

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[keywords] Laser Ablation Backwriting, Metal films, Glass.

The use of lasers to achieve transformations at interfaces, either on solids under air, controlled atmospheres or a diversity of liquid environments, is evolving at a fast pace and in-line with recent advances in photonic technologies [1]. The singular properties of lasers, which provide a choice of emission parameters, such as emission wavelength, pulsed or cw mode and pulse width, together with the use of optomechanical means to scan in beam or line fashion, are ideal in order to trigger physico-chemical phenomena which are not available with alternative methods and are, at large, based on thermally activated processes. Recently developed methods in our Laboratories include those that are based, on the one hand, on strongly photothermal interactions [2,3]; on the other, on mixed type interactions, where photothermal, photophysical and, in some cases, photochemical types may cohexist [4,5]. In the former case, a solid may melt and, with the controled laser movement, directionally solidify into a material with controlled microstructure. In the latter case, an ablation process with extreme physical or chemical consequences may be triggered and be localised at the irradiated interface. A brief description of the phenomena behind laser-solid interactions will be presented, along with results obtained with the Laser Ablation Backwriting (LAB) method and applied to surface modification of glass. This has been recently developed in order to modify physico-chemical and functional properties of glass surfaces at large, based on this fully scaleable method. In particular, selective metallization of glass surfaces will be addressed in this talk.

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IS22

Nanostructured materials for highly sensitive optoelectronic detectors

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[keywords] graphene, quantum dots, hot electrons, terahertz detectors.

Atomically thin materials like graphene and transition metal dichalcogenides (TMDs) have emerged as a versatile platform to study physics in reduced dimensions and for applications in ultra-thin electronics on flexible substrates. They are particularly suitable for optoelectronics, due to their direct bandgap (for monolayer semiconducting TMDs) and their considerable light absorption. For a gapless material like graphene, light absorption occurs in a wide energy range, including ultraviolet, visible, telecom and terahertz radiation, a region of the electromagnetic spectrum where highly sensitive detection is notoriously difficult. Light absorption in graphene causes a large increase in electron temperature, making it an ideal material for hot-electron bolometers. Nanostructuring graphene into quantum dots introduces an energy gap due to quantum confinement, while still preserving broadband detection and yielding extraordinary performance. I will review our recent work on the realization of these highly-sensitive detectors and their applications.

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IS23

The Adhesion Properties of c-BN Films Coated Using HiPIMS and Pulsed-dc Magnetron Sputtering

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[keywords] c-BN, adhesion, HiPIMS, pulsed-dc

Nitrides and carbides films are common used industry due to their good properties (high hardness, low friction, good adhesion). Among of them, c-BN films has very popular in industry. Furthermore, the properties of c-BN films are better than other nitride and carbides films. Generally, c-BN is compared to diamond because of its properties such as hardness, bond structure, etc. Besides, some of the properties of c-BN films are superior to diamond. The oxized and graphization temperatue of c-BN films are 1200 ºC and 1500 ºC, respectively. These values for diamond are 600 ºC and 1400 ºC, respectively. The c-BN is chemically inert, although the diamond is released fume when exposed to magnetic metals [1-3]. However, some of these films like c-BN has no good adhesion because of instric compressive stress. For this reason, the scientists have studied to improve the adhesion [4-6]. In this study, to compare adhesion between the substrate and coating, the c-BN films were coated on 4140 steel using closed field unbalanced magnetron sputtering (CFUBMS) with high impulse power magnetron sputtering (HiPIMS) and pulsed-dc applied to the targets. The structural properties of c-BN films were examined using SEM. The microhardness and critical load properties of c-BN films were carried out using Knoop indernter and scratch tester, respectively. The results showed that the adhesion properties of c-BN films coated HiPIMS are better than the adhesion properties of c-BN films coated pulsed-dc.

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IS24

THz Emitters Using High-*T*c Superconducting Bi-2212 Mesa Structures: Applications for High Resolution and High Sensitivity Molecular Spectroscopy

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High-Tc superconductors with highly 2D layered structures of CuO2 plane, which is responsible for the high-Tc superconductivity, like a Bi2Sr2CaCu2O8+δ (Bi-2212) compound can generate rather intense THz electromagnetic waves after proper mesa structures were fabricated with certain dimensions and shapes [1]. The emission frequency spreads over a wide range of frequency domain from 0.3 THz to 2.4 THz more or less continuously [2] and the intensity can be up to 640 mW in case of three mesas synchronously operated [3]. The spectrum of THz radiation is sharp, a few tens of MHz due to synchronization of a few thousands of intrinsic Josephson junctions in a stack along the c-axis. The mechanism of such a synchronized radiation can essentially be understood by the same mechanism as one on the LASER. Because of sharp spectrum of the THz radiation, the peak spectral intensity is extremely high, about 103-104 times stronger in the THz region than that of Hg lamp sources commonly used as a THz source. Using this characteristic feature of IJJ THz emitters, it is possible to construct high sensitivity spectrometer.

This spectrometer is planned to use for the various applications. One of the interesting applications is to selectively detect and analyze unknown organic compounds contained in lipids produced by algae as byproducts, such as Botryococcene oil from Botryococcus braunii, Squalene or Squalane from Aurantiochytrium, etc. This subject is very important for future health sciences to support a long healthy human life society in near future.

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IS25

Epitaxial Non-c axis Bi-2212 Thin Films

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[keywords] Thin films, (117) $Bi_2Sr_2CaCu_2O_8$, MOCVD

For electronics applications high quality thin films are necessary. High temperature superconductor $Bi_2Sr_2CaCu_2O_{8+\delta}$(Bi-2212), considering its relatively high anisotropy and its layered structure composed of alternative superconducting (S) and insulating (I) blocks, is a candidate for intrinsic SIS Josephson Junction devices. Fabrication of high quality films with different orientations is important in this regards.

In this work we performed growth of epitaxial thin films of (117) Bi-2212 at different temperatures by MOCVD on (110) $SrTiO_3$ and (110) $LaAlO_3$ substrates. The problems to solve are related to the undesired occurrence of impurity orientations and phases and to formation of twins. Impurity and twins influence in a negative manner the current flow and therefore they should be removed. Our approach is to use flat or vicinal substrates with off angles up to 20 . As-obtained films are 3D epitaxial and X-ray diffraction-scans demonstrate that, while the films grown on a flat substrate are composed of twinned grains, the films on vicinal substrate are *twin-free*. Films on the flat substrate grow by a 2D *layer-by- layer* mechanism and films on the vicinal substrate grow by the *step-flow* growth mechanism. A higher quality, namely twins- and impurity- free films are obtained if growth is performed by a *two-temperature* approach: growth starts at a lower temperature and continues at a higher one. For the films grown by the *two-temperature* approach on vicinal substrates, the zero-resistance critical temperatures (T_C), when the measuring current is applied *in-plane* parallel (37 K) and perpendicular (32 K) to [001] direction of the substrate, are less different than for the films grown on flat substrates and by *one-temperature* route. The result supports conclusions of the structural characterization.

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IS26

Crystal Structure and Surface Phase Composition of Palladium Oxides Thin Films for Gas Sensors

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[keywords] nanostructures, gas sensor, ozone, nitrogen dioxide, microstructure, surface state

An aspiration of ozone and nitrogen oxides can provoke a variety of human health problems, particularly for the children, the elderly, and for the people with lung diseases [1]. Moreover, under sunlight, the interaction of ozone, nitrogen oxides, and volatile hydrocarbons can produce many toxic organic compounds. Thus, the detection of toxic oxidizing gases in the ambient air is one of the critical tasks concerning the environment protection and quality of life. Palladium (II) oxide nanostructures are demonstrated to be promising candidates for detection of oxidizing gases [2]. Gas sensors based on PdO nanostructures such as ultrathin and thin films show excellent sensitivity, signal stability, operation speed, short recovery period, and reproducibility of the sensor response [3].

In this work the influence of oxidation temperature on microstructure and surface properties of palladium (II) oxide thin films prepared by oxidation at dry oxygen has been studied by X-ray diffraction (XRD), scanning electron microscopy (SEM), and X-ray photoelectron spectroscopy (XPS). XPS technique has been applied with the use of high brilliance synchrotron light of Helmholtz-Zentrum-Berlin BESSY-II storage ring. Russian-German lab's beamline end-station was equipped with SPECS Phoibos 150 electron energies analyzer, which gave high resolution binding energies data for Pd and O atoms under 800 eV photon excitation energy. The conditions of XPS experiment have corresponded to less than 2 nm probing depth. It is found that oxidation temperature rise up to T_{ox} = 1070 K leads to an increase in *a* and *c* lattice parameter values (PdO has tetragonal crystal structure, space group $4_2/mmc$). SEM results show that changes in lattice parameter values have accompanied by the increase in the crystallite size, porosity, and roughness. According to the XPS surveys data the total amount of oxygen and palladium atoms are in nearly equal amount in case of films oxidized at T_{ox} = 870 K and 1070 K. This fact indicates the absence of the noticeable degradation of palladium oxide surface in the temperatures range T_{ox} = 870 – 1070 K. Detailed registration of the well pronounced Pd 3d core level XPS peaks confirms this stability from the point of view of Pd atoms chemical states and their relative contribution. Regardless of oxidation temperature value of palladium oxide films three components of each Pd 3d 5/2 peaks can be attributed to $Pd(OH)_x$, PdO, and PdO_2 (from low to high binding energies, Fig. 2). Analysis of peak component contribution has shown that PdO is dominant surface phase. The intensities ratio between pronounced PdO_2 component (~ 337.8 eV) and $Pd(OH)_x$ component (~ 336.1 eV) with relatively lower value remains the same. This fact confirms the composition stability of surface phases for palladium oxide films oxidized at temperature range T_{ox} = 870 – 1070 K. The experimental data will be used for modeling of PdO nanostructures formation regimes providing the optimum gas sensor functional properties.

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IS27

Polarization Properties of Terahertz Radiation Monolithically Generated from $Bi_2Sr_2CaCu_2O_{8+\delta}$ Mesas.

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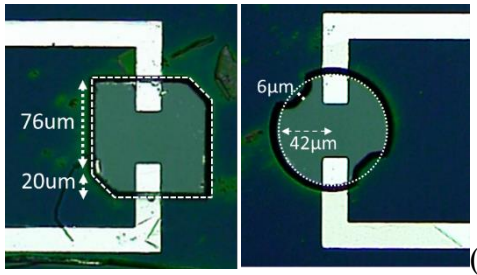
[keywords] Intrinsic Josephson Junctions, terahertz waves, polarization

Continuous-wave terahertz sources made of high-T_c superconducting $Bi_2Sr_2CaCu_2O_{8+\delta}$ (Bi2212) have been extensively studied both experimentally and theoretically since ten years ago [1]. This type of THz sources has a compact size with large frequency tunability ranges, and highly monochromic radiations. Polarization properties of Bi2212 based devices have not been investigated very well [2–4] despite of their importance for practical applications. It is known that circularly polarized (CP) electromagnetic wave is achieved in labs by introducing optical devices (e.g., quarter wave plate) into the beam path. Nevertheless, monolithic generation of CP is preferable because CP has a great advantage for mobile communications. Generation of CP THz wave from Bi2212 has been numerically suggested in multiple publications [2,3]. In this study, we experimentally demonstrate emission of CP THz waves from Bi2212 devices and discuss the polarization properties of the emissions using methods similar to that applied by microstrip patch antennas [6]. The achieved circular polarization states are desigined by using the truncated edge square mesa shape [3,4] and cylindrical mesa shape with notched sides as shown in Figs. 1(a) and (b) respectively. The axial ratio (AR) representing polarization state was found to be less than 3 dB in both mesa geometries, which indicates a highly circularly polarized radiation. Evolutions of AR and other polarization parameters provide novel insights to reveal synchronization mechanism of the Bi2212 THz emission.



(a) (b)

Fig. 1 (a) Truncated edge square mesa.

(b) Cylindrical mesa with notched sides.

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ŞİŞECAM

SPECIAL SESSION

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SS01

Presentation of Science and Technology Center of ŞİŞECAM

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To be Announced

SS02

The Effect of Oxygen Partial Pressure on the Electrochromic Properties of WO_{3-x} Grown by Magnetron Sputtering on Ga-Doped ZnO

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[keywords] Electrochromic materials, tungsten

Electrochromic materials can change their optical properties reversibly/persistently upon ion charging/discharging in response to an applied voltage. This property brings great interest in many applications such as smart windows and energy efficient buildings. Tungsten trioxide (WO_{3-x}) is the most studied electrochromic material due to its promising properties like high coloration efficiency and short switching time.

In this work, the influence of the reactive oxygen gas pressure on the electrochromic properties of WO_{3-x} was studied. WO_{3-x} layers with a film thickness of 160±5 nm were grown by RF magnetron sputtering on Ga-doped ZnO pre-coated glass substrates (6x6 cm^2). A series of WO_{3-x} films were deposited at different $O_2/Ar+O_2$ mass flow ratios changing from 20% to 70% at a constant sputtering pressure of $3.5x10^{-3}$ torr. Electrochromic measurements; cyclicvoltammetry, chronoamperometry and lifetime cycle measurements were performed. A Silver-Silver Chloride electrode as a reference and a platinum wire as a counter electrode were used. 0.3Molar Lithium Perchlorate-Propylene Carbonate solution was used as an electrolyte.

A strong relation between the oxygen partial pressure and the WO_{3-x} electrochromic properties was observed. At low $O_2/Ar+O_2$ mass flow ratio of 20-25%, no big difference was observed in coloration efficiency and transmission modulation. In this range of gas flow, the coloration efficiency was recorded as 68 cm^2/C and the transmission modulation was about 72%. By increasing the $O_2/Ar+O_2$ mass flow ratio from 20-25 to 30-70%, a gradual decrease with the transmission modulation to 55% was observed. However, the coloration efficiency did not reveal a big change even at high O_2/O_2+Ar mass flow ratio of 70%. For all samples, the bleached state transmissions were recorded as 86% independent of O_2/O_2+Ar ratio. However, the color state transmission increased from 17% to 30% with raising oxygen percent. This means that the WO_{3-x} film was not bleached completely after the first cycle electrochromic measurement and hence the coloration level decreased further with the following cycles. This could be explained with the formation of the interstitial oxygen (O_i) in the WO_3. These oxygen atoms behave as trapping centers and react with Li atoms. Because of the reaction, Li_2O_i forms, which is called as Lithia (1, 2). With more cycling, the number of Li trapping in the layer rises which results in degradation of the electrochromic properties of the WO_3 films.

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SS03

Ion Exchange Strengthening of Silicate Glasses

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[keywords] ion-exchange strengthening, chemical tempering, sodium alumina silicate glass, lead free crystalline glass, bath technology, KNO_3.

Ion exchange is a chemical strengthening technique that aims to improve the mechanical strength of glasses by modification of the surface chemical structure via immersion of the glass into a molten KNO_3 salt bath, wherein small sodium ions in the glass structure are replaced by potassium ions, thereby inducing the formation of a compressive stress layer. This study compares the ion exchange behaviors of sodium alumina silicate glass composition, lead free crystalline glass composition and two different soda lime silicate glass compositions with different alumina contents by applying KNO_3 salt bath at varying temperatures and time intervals. Mechanical properties of ion exchanged glasses in terms of strength, hardness and cracking were studied. The magnitude of residual stress and depth of stress layer of the glass samples after ion exchange were measured by surface stress meter which is based on the theory of photoelasticity. Depending on the glass composition and thickness, an optimum layer thickness of 5–50 μm was found to be adequate to counteract the surface flaws responsible for glass fracture. Increase in the hardness, substantial enhancement in the indentation crack resistance, as well as three times higher bending strength on average were achieved for all of the ion exchanged glass samples compared with the original glasses. Well-known positive effect of alumina content and mixed alkali effect of glass composition on the ion exchange reaction in sodium alumina silicate glass also manifested itself in the case of soda lime silicate glass and crystalline glass composition.

SS04

The Effect of Sputtering Power and Oxygen Partial Pressure on the Electrochromic Properties of NiO Grown by Magnetron Sputtering on Ga-Doped ZnO

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[keywords] Electrochromic materials, NiO, anodic material

The optical band gap of the electrochromic materials is changing by an oxidation/reduction reaction upon charging/discharging of ions and electrons in the material. Among the other transition metal oxides, NiO is the most preferred anodic color material for electrochromic applications. The color of NiO changes from brownish to colorless upon charging/discharging of ions and electrons.

The goal of this work is to show the relationships between the sputtering growth parameters and the electrochromic properties of NiO thin films. This was conducted by examining NiO thin films grown at different powers and different $O_2/Ar+O_2$ mass flow ratios. At the first phase, a series of NiO thin films was grown at different sputtering powers changing from 60W to 160W. At the second phase, $O_2/Ar+O_2$ mass flow ratio was varied from 10% to 65% at a constant growth pressure of $8.2x10^{-3}$ torr. The thicknesses of the layers were 150±5 nm. The electrochromic behavior was studied by cyclic voltammetry (CV) on a potenciostat. All films were electrochemically cycled in 0.3 M LiClO4-PC using a three-electrode arrangement, with NiO as the working electrode, platinum wire as counter electrode and Ag/AgCl as the reference electrode.

Increasing the growth power from 60W to 90W lead to an increase in the intercalated charge density from 8.2 mC to 11.2 mC. As a result, the optical density was increased from 0.48 to 0.73. As an effect of the change in the optical density, transmission modulation raised from 31% to 38%. Further increasing of the sputtering power to 160W caused a decrease in the charging capacity and optical density. Consequently, the transmission modulation was decreased. As a summary of the second phase, raising $O_2/Ar+O_2$ mass flow ratio from 10% to 65% resulted in an increase in the optical density and transmission modulation. The highest values for optical density and transmission modulation (as 0.73 and 38%, respectively) were found at $O_2/Ar+O_2$ mass flow ratio of 65%, respectively.

Contributed Talks

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CT01

$YBa_2Cu_3O_{7-x}$ Superconducting Thin Films with Nanostructured Synergetic Pinning Centers grown by PLD

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[keywords] Superconducting films, Nano-engineered pinning centers, PLD.

The earliest cost-effective method used for introducing artificial pinning centers in superconducting films was the so-called substrate decoration approach [1]. Later on, two other approaches proved to be successful in the nanotechnology of pinning centers: building up a layered distribution of a second phase using multilayer deposition (quasi-superlattices), and, secondly, by the distribution of secondary phases of nanoscale grain dimensions in the film achieved by a modified target composition. For many practical applications of YBCO coated conductors, artificial ***synergetic*** pinning centers, introduced in more than one way (substrate decoration, quasi-multilayers, and targets with secondary phase nanoinclusions) have been investigated in recent years [2-4] with very promising results.

We report an enhancement of critical current density (J_c) and unusual behavior of its dependence on field orientation in $YBa_2Cu_3O_{7-x}$ (YBCO) nanostructured films by a combination of substrate decoration with Ag nano-dots, of incorporation of $BaZrO_3$ (BZO) nano-particles and nano-rods, and of multilayer architecture using $SrTiO_3$ (STO) nano-layer separating two 1.5 μm-thick YBCO layers. Such thick nanostructured films show significant improvement of J_c in magnetic field along the the *ab*-plane direction, apart from the usual increase of J_c in magnetic field along the *c*-axis direction. The presence of BZO nano-rods, *ab*-plane defects and nano particles of BZO and Y_2O_3 was observed in Transmission Electron Microscopy (TEM) images of the film. The peculiarities of artificial pinning centers revealed in the TEM images of the nanostructured films, induced by the stress at the YBCO/STO interfaces, are consistent with an unusual dependence of J_c on the magnetic field direction which shows a splitting of the usual maximum for fields parallel to the *c*-axis [5].

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CT02

Nonlinear Properties of Hydrogenated Amorphous Silicon-Chalcogen Alloys Thin Films

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[keywords] Thin films, amorphous silicon- sulphur/selenium alloys, z-scan, infrared spectroscopy, nonlinear properties, third order susceptibility, figure of merit.

Hydrogenated amorphous silicon-halogen alloys thin films were grown by capacitively coupled radio frequency glow discharge technique. Chalcogens used in this experiment are mainly sulphur and selenium. Diluted SiH_4, and H_2S or H_2Se gas mixtures were used in the preparation process to reduce potential hazardous outcome. Infrared spectroscopy shows that the material exhibits characteristic vibrational modes of sulphur or selenium in a silicon matrix. Nonlinear properties of the silicon alloys were investigated using z-scan technique. The measurements were carries out using continuous wavelength (CW) laser sources at excitation wavelengths of 488 nm, 514.5 nm, and 632.8 nm. For each excitation wavelength, the nonlinear absorption and nonlinear refractive index coefficients were measured. The origin of nonlinearities was discussed. The third order nonlinear optical susceptibility $\chi^{(3)}$ was calculated for each type of alloy thin film. The figure of merit shows that these alloys are ideal for applications in all-optical switching.

CT03

Efficiency Analysis of CZTS Based Solar Cells

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[keywords] Cu_2ZnSnS_4 (CZTS), thin film solar cells, magnetron sputtering, XPS.

The quaternary compound of Cu2ZnSnS4 (CZTS) is a newly explored p-type semiconductor photovoltaic material which attracts so much attention in photovoltaic industry due to its low cost, earth abundant properties as well as consisting of 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, recently 12.6% efficiency has been achieved which demanding further improvement [1]. The CZTS thin films show p-type conductivity, high absorption coefficient (104 cm-1) and a band gap of 1.45-1.5 eV that is ideal to achieve the highest solar-cell conversion efficiency [2]. The high efficient Cu2ZnSnS4 (CZTS) based thin film solar cells needs the synthesis of phase pure CZTS absorbers [3]. 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 this work, Mo coated soda lime glasses (SLG) were used as a substrates. CZTS absorber layers were grown on Mo coated SLG substrates using two stages which are the magnetron sputtering of metallic precursors, followed by a heat treatment under sulfur vapor atmosphere. To obtain CZTS absorber films, all precursors were sulfurized using sulfur powder at 550 °C for 45 min under Ar gas atmosphere. CZTS based solar cells were fabricated using SLG/Mo/CZTS/CdS/ZnO/AZO structure. The effect of CdS buffer layer thickness on the photoconversion efficiency of solar cells was investigated [4]. For the structural characterization of CZTS absorber layer, the Raman Spectroscopy, X-Ray Diffraction (XRD) and Scanning Electron Microscopy (SEM) were used. The atomic compositional ratio was studied using Energy Dispersive X-ray Spectroscopy (EDX) and X-Ray photoelectron spectroscopy (XPS) quantitive analysis. This study revealed a correlation between the thickness of CdS buffer layer and efficiency of CZTS based solar cells.

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CT04

Controlled growth of Pd-Cu and Pd-Au bimetallic nanostructures and films by chemical vapor co-deposition method

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MOCVD, palladium, copper, gold, co-deposition

Pd-Cu and Pd-Au materials are widely used in heterogeneous catalysis [1] and in hydrogen-based industry [2,3] due to their possibility to selectively permeate hydrogen through the crystal structure and to withstand high temperature application with no transition into the β-PdH phase and suffer from poisoning by active gases such as CO_2, H_2S. One of the most perspective ways to prepare such materials is metal-organic chemical vapor deposition (MOCVD) from two independent hot precursor's sources allowing to create high-quality conformal nanostructures on the complex-shaped non-conducting substrates [4] in a single deposition process. The method feature is the material formation by controlled mixing of vapors of palladium and copper (or gold) complexes on the atomic level on the substrate surface and their thermal decomposition initiated by reactant gas (in this case by hydrogen). MOCVD method is multiparametric and such conditions as deposition and evaporation temperatures, carrier and reactant gases flow rates, exposition time and total pressure in the reactor directly influence on the nanostructure, microstructure, component and phasic composition of the material. Furthermore, as it was mentioned before the key stage of the MOCVD process is the thermodestruction of vapor-phased precursors that's why to precisely control the deposition process the investigation of precursors' thermal behavior on the substrate heated is required.

In this study using combinations of low-temperature Pd, Cu, Au precursors ($Pd(hfac)_2$ – bis-1,1,1,5,5,5-hexaluoroacetylacetonatopalladium (II), $Cu(cod)(hfac)$ – 1,4-cyclooctadienyl-1,1,1,5,5,5-hexaluoroacetylacetonatocopper (I), $[Me_2Au(OAc)]_2$ – dimethylgold(III) acetate) Pd-M (M – Cu or Au) films are deposited in a vertical cold wall reactor at low pressure (LP-MOCVD) onto Si or YSZ/Si substrates. The phase and elemental composition, microstructure of Pd-based films is analyzed by methods of XRD, XPS, EDX and SEM. The obtained data were compared with the results of *in-situ* mass-spectrometric investigation of Pd-Cu, Pd-Au precursors' vapors thermal decomposition on the heated substrate in H_2 atmosphere. This unique method completely reveals the thermal behavior of vapor-phased precursors individually and together in the conditions of MOCVD experiment. As results it is demonstrated how the precursors nature and co-deposition conditions (deposition and evaporation temperatures, carrier and reactant gases flow rates, etc.) can affect the grown kinetics, phase formation under non-equilibrium conditions and features of thermal decomposition of precursors' vapors on a hot surface.

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CT05

Effect of Sulfurization Duration and Cu-Sn Layer Adjacency in Metallic Precursor of Cu_2ZnSnS_4 Absorber Layer on the Performance of Zn(O,S) Buffered Solar Cells

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[Keywords]: Cu_2ZnSnS_4 (CZTS) absorber layer, Zn(O,S) buffer layer, DC magnetron sputtering

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 [1,2]. In the present work, CZTS absorber layers were prepared following a two-stage process: firstly, a stack of metal precursors (Cu/Sn/Zn/Cu) were deposited on molybdenum (Mo) substrate by magnetron sputtering, then this stack was annealed under sulfur atmosphere inside a tubular furnace [3,4,5]. CZTS thin films were investigated using energy-dispersive X-ray spectroscopy (EDX), X-ray diffraction (XRD), scanning electron microscopy (SEM) and Raman spectroscopy. The effect of sulfurization time and the thickness of top and bottom Cu layer in precursors on the properties of CZTS thin films were investigated. We addressed the importance of Cu layer thickness adjacent to Sn to avoid developing detrimental phases and to get complete formation of kesterite CZTS absorber layer. We also addressed the importance of sulfurization time to restrict the Sn and Zn losses, formation of oxides such as SnO_2 and ZnO, and formation of MoS_2 and voids between Mo/CZTS interface. Moreover, we succeeded substitute conventionally used CdS buffer layer with environmentally friendly alternative Zn(O,S) buffer layer in CZTS solar cells.

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CT06

Effect of Ca-doped on the structural and dielectric properties of Ni-Zn ferrites prepared by co-precipitation method

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[keywords] Ni-Zn Ferrites, Co-precipitation, Dielectric properties

Recently, spinel ferrite nanoparticles have facilitated novel advances in nanoscience and nanotechnology due to their considerable magnetic and electrical properties, and diverse potential applications [1]. Ferrites are valuable materials because they are cheap and stable than its counterparts. Ferrites are separated from their duplicate with their unusual physical and chemical properties. Ferrites are favored in technological applications with their high resistivity between the frequency ranges from microwave to radio frequency [2]. Nowadays, ferrite materials can be used for several applications such as gas sensors, electromagnetic interference (EMI) suppressors, magnetic memories, microwave absorbers and broadband transformers [3-5]. It is well known that Ni-Zn ferrite, which is the one of the most important member of the spinel ferrite family, has excellent properties such as low dielectric losses, high resistivity, mechanical hardness, low cost and chemical stability [6]. However, the properties of these ferrites have been defined by influence factors such as the preparation method, chemical composition, sintering temperature and substitution cations. There are several methods to synthesize the ferrite materials such as chemical co-precipitation method, citrate-gel technique, hydrothermal, sol-gel process, thermal evaporation, wet-chemical technique [6], etc. Among these techniques, the co-precipitation method is the most preferable method in all the others. The reason for that it has easy, inexpensive and short processing step.

In the present work, chemical co-precipitation method has been used to synthesize the Ca doped Ni-Zn ferrite nanoparticles. Ca^{2+} doped modify the structural and dielectric properties of ferrites considerably. The occupancy of Ca^{2+} into the spinel lattice would create a lattice distortion due to its larger ionic radius. As results, the modification of material properties to an appreciable extent is expected. The structural properties of this ferrite nanoparticles have been analyzed using X-Ray diffractometer. Also scanning electron microscope (SEM) used to investigate the nanostructure and morphology of the sample. To determine the electrical properties of the sample, the real and imaginary parts of the dielectric constant have been investigated to a frequency range from 20 Hz to 10 MHz. These measurements have been also repeated for different temperatures.

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CT07

A Modified Fabrication Route for Tl-2223 Superconducting Thin Films to Obtain a High Critical Current Density

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[keywords] (Tl-2223) superconducting thin films, HTS superconducting thin films

Superconducting thin films are very important in today's technology. Nowadays, HTS superconductors, which have a history of about 30 years, are still being studied. According to both the technological needs and superconducting materials' abilities, these studies are mainly concentrate on thin/thick films and wires/tapes, and the results obtained are promising.

In this work to obtain a pure phase $Tl_2Ba_2Ca_2Cu_3O_{10}$ (Tl-2223) films with good transport properties, we used classical dc magnetron sputtering method but modified the annealing stages and we add a Tl pre-coating just before coating of the main matrix. At the pre-coating stage ~400 nm thick Tl was coated on to the heated substrates under vacuum. Then Tl coated substrates were re-coated with the main matrix and a quadripartite post-annealing process was applied in a specially designed chamber. The results of X-ray diffraction (XRD) θ–2θ scans, ω scans and rotational ϕ scans show that all films produced has single phase Tl-2223 and an epitaxial *c*-axis oriented structure. The phase homogeneity is also checked by scanning electron microscopy (SEM) and Energy Dispersive X-ray mapping (EDX). The critical temperatures T_c of the films are measured to be approximately 120 K at zero field. The magnetic properties are also examined under the applied field of 9T. The transport critical current densities J_c can reach to 1.20 MA cm^{-2} at 77 K under 8T. The results obtained suggested that pre-coating of substrates with Tl and a quadripartite post-annealing process could be an alternative processing method for high quality Tl-2223 thin film superconductor fabrication.

CT08

Thin Films Deposited from Graphene Oxide Nanosheets and Metal/Metal Oxide Nanostructures for Electrochemical Supercapacitors

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[keywords] Graphene Oxide, Layer-by-Layer deposition, electrochemical supercapacitors

Electrochemical Capacitors are electrical energy storage devices that have higher power density and longer cycle life than batteries due to quick ion/electron transport and lack of phase change during charge-discharge. They have also higher energy density than conventional dielectric capacitors due to fast redox reactions taking place on the surface. (1) Electrodes produced from graphene and metal oxide composites have achieved extraordinary electrochemical performance due to combination of individual properties of these two material classes. Graphene promotes fast electron transport with its excellent electrical conductivity, and metal oxides enhances energy density of the system by utilization of redox reactions between multivalent ions present in the structure. (2) Herein, graphene-metal oxide thin films were produced with a simple dip coating technique. Both graphene oxide and metals or metal oxides were obtained via wet chemical routes. The structural and electrochemical properties of films were investigated for different number of layers deposited on a substrate.

Herein, I will demonstrate properties of thin films of iron oxide or nickel hydroxide deposited together with graphene oxide with Layer-by-Layer (LBL) methods. LBL growth of the films was monitored with UV-Vis Spectroscopy and Quartz Crystal Microbalance. According to the absorbance spectrum and QCM results, successful formation of hierarchical structures by layer by layer assembly was obtained. Graphene oxide has intrinsically low electrical conductivity due to the presence of oxygen functional groups. To increase the electrical conductivity of the films, chemical reduction with hydrazine was conducted. The effect of hydrazine reduction on the structure of the films was investigated with Atomic Force Microscopy and X-Ray Photoelectron Spectroscopy (XPS). XPS measurements demonstrated that the C and N percentage in the film increased after hydrazine treatment indicating that both reduction and nitrogen doping was achieved simultaneously. Also, Cyclic Voltammetry measurements were conducted before and after hydrazine reduction to elucidate the effect of conductivity on the energy storage capability. After reduction, spion/GO films had areal capacitance of 2.39, 1.70, 1.05, 0.76, and 0.65 mF/cm2 at scan rate of 20 mV/s for 9, 7, 5, 3, and 1 bilayers, respectively. These values are almost two times larger than the areal capacitances of the films before reduction. The film with 9 bilayer spion/GO reached areal capacitance of 3.80 mF/cm2 at 5 mV/s. For Nickel hydroxide/Graphene oxide films, the areal capacitance values were tuned between 0.4 and 4.5 mF cm-2 by increasing the bilayer number from 1 to 9.

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CT09

Investigating Design Parameter Depence of Resonant Frequency on THz Metadevices: Theory, Numerical Simulations and Experimental Characterizations

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[keywords] Terahertz waves, metamaterials, Time Domain Spectroscopy.

Terahertz (THz) radiation is part of the electromagnetic spectrum lying between microwaves and the infrared correspond to wavelengths from 3 millimeters up to 3 micrometers. Military and defense applications are requiring the development of many technologies such as handheld THz radar systems in this frequency range to remotely detect the presence of explosive materials, poison gases, ceramic weapons, and biological warfar eagents like viruses and bacteria [1-4]. In Terahertz technology, metamaterials have an important place in the design of artificial optical elements since they exhibit electromagnetic properties that can not be obtained from natural materials and can be designed with the desired functionality. The resonant effects that the metamaterials show at different terahertz frequencies have started to gain a very important place especially in terms of the detection and spectroscopic methods. In this study, simulation and transmission measurements of THz thin film metamaterial filters have been carried out and these devices are compact, demonstrate an easy and available fabrication process. Our results are consistent with the simulation results. The design predictions for the center frequencies and bandwidths of the resonances due to the unitcell structures are formalized by the measurements of terahertz time-domain spectroscopy. The obtained measurement data have been discussed in the view of surface conductivity of deposited films. It is observed that material type of the filter has not any influence on the resonant frequency on the other hand, there was a reduction in the transmittance peak due to reduced film conductivity. In the analysis of physical background for the process in the different metamaterial structures the usual theoretical model of extraordinary optical transmission (EOT) has been used. In the development of resonant transmission, surface electromagnetic modes that the origin of the enhanced transmission from single apertures surrounded by periodic corrugations have a crucial function. Each mesh parameter of the proposed unique metamaterial design has effected the resonance frequency in a lineer of nonlineer way. The most narrow resonance peak could be obtained by careful variation of unit cell parameters.

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CT10

Estimations of Geometrical Dimensions of Nanostructures

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[keywords] Quantization of electrical conductance, Nanostructures, Geometrical Dimensions.

The electrical conductance of nanostructures within the atomic size is changed stepwise as a function of the cross section area of a nanostructure at its narrowest point [1]. The effect of quantization of electrical conductance (resistance) with the quantum $G_0 = 2e^2/h = (12.9k\Omega)^{-1}$ occurs for nanostructures under the conditions given by Landauer in his new definition of conductance [2]: that the nanostructure is made of electrical conductor; that the nanostructure (sample) has a constriction (narrow throat) between two wide terminals; that the thickness of the nanostructure is comparable with the Fermi wavelength λ_F; and that the length of the constriction is smaller than the mean free path l_e in material of a sample.

The effect of conductance quantization can be used to measure the width W of nanostructures, or rather to estimate it - see Fig. 1: $R \rightarrow G \rightarrow N \rightarrow W$. Electrical measurements of geometric sizes of nanostructures are potentially very important for nanotechnology, where other methods of measurement are very complex. The new method here proposed is based on electrical measurements. Therefore, the measurements are relatively simple and the results of measurement are more accurate when nanostructures is smaller.

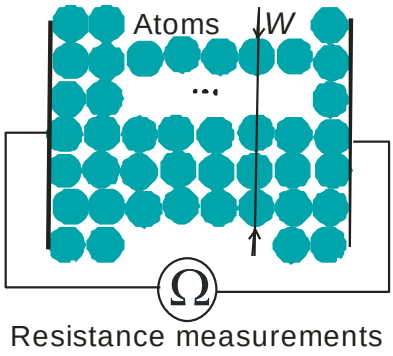

Fig. 1 Estimations of the width of a nanostructure by electrical measurements (R – resistance, G- conductance, N – number of transmission channels, W – width)

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CT11

$PEG_{40}St$ Squeeze out from Lipid Monolayers

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PEG40St and DSPC are main components for microbubbles used as ultrasound contrast agents in medicine. DSPC:PEG40St mole ratio of 9:1 is generally reported in the literature for the microbubble formulation. However, the stability of the microbubbles is relatively short in circulation system during diagnosis. It was shown from Langmuir monolayer compression and Brewster angle microscopy (BAM) that almost 90% PEG40St squeezed out from 9:1 mixture of DSPC:PEG40St at the first collapse pressure of 31 mN/m which was close to PEG40St collapse pressure of 35 mN/m and totally squeezed out at 59 mN/m which was the collapse pressure for DSPC. BAM images indicated mushroom to brush conformation changes upon compression. In the light of monolayer results, microbubbles were prepared at differnt DSPC/PEG40St mole ratios and their stabilities were analyzed. During the talk, the developed PEG40St squeeze out quantification method and a method to analyze the BAM images for the PEG40St conformation changes will be introduced. Then, our results on the effect of higher PEG40St content on the microbubble stability will be analyzed.

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CT12

Thin Silver Film Synthesis on Polymeric Composite Surfaces via Electroless Deposition Technique

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[keywords] Polymeric composites, Silver thin films, Electroless deposition, Reflective surfaces.

Formation of metallic films on polymeric surfaces has attracted great attention recently, since the final product exhibits various optical, electrical, or magnetic properties [1]. Polymeric substrates have many advantages such as lightweight, flexibility and shock resistance, when compared to inorganic substrates like glass [1-2]. Surface-metallized polymeric surfaces have many potential applications including bactericidal coatings, contacts in microelectronics, highly reflective thin film reflectors and concentrators (especially in space environments), lightweight optical mirrors and solar dynamic power generation [1-3]. Silver coated polymeric surfaces have been an active area of interest for these application areas, since silver has high electrical conductivity and excellent reflectivity, besides its modest cost [1-3]. Among the various methods developed to deposit silver film on polymeric substrates, electroless plating technique provides a low-cost, solution-based method at atmospheric conditions, and is a promising option for large-scale production.

In this work, highly reflective polymeric surfaces for use in solar collector systems were developed using silver films with electroless deposition method. Vinyl-ester matrix composites reinforced with glass fibers were produced and then used as polymeric substrates. As a first step, catalytically active sites on the polymer surface were generated either by acidic ($SnCl_2$/HCl) or basic (NaOH) treatments for the subsequent deposition process. Effects of treatment procedure and treatment time were investigated in detail to enhance the adhesion and surface coverage of the resultant silver coatings. Surface atomic composition, roughness profiles and hydrophilicity change of the surfaces before and after treatment were analyzed by X-ray photoelectron spectroscopy (XPS), atomic force microscopy and contact angle measurements, respectively. Tollens' process was then applied to deposit silver layers on the surfaces having different pretreatments. Electron microscopy (SEM), XRD and XPS methods were employed to characterize the resultant films. XRD results proved the growth of silver film on the surface and no impurities were present in the film. Small-sized (~30 nm), and evenly distributed silver crystals with a film thickness of ~100 nm were observed over the surface in SEM images. UV/Vis spectrometer analysis confirmed the high reflectivity of the silver deposited polymeric surfaces (96-97% at 550 nm), indicating their potential applicability in solar collectors.

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CT13

Characterization of $Cu_2ZnSn(S_xSe_{1-x})_4$ thin films prepared by annealing of stack precursors in Se vapor

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[keywords] $Cu_2ZnSn(S,Se)_4$, kesterite, selenization, thin films, solar cells.

Quaternary semiconductors Cu_2ZnSnS_4 (CZTS), $Cu_2ZnSnSe_4$ $(CZTSe)_4$ and their solid solutions $Cu_2ZnSn(S,Se)_4$ (CZTSSe) with kesterite structure, have attracted a lot of attention as promising absorber materials for future photovoltaic systems. These materials have favorable photovoltaic properties like high absorption coefficient, direct bandgap ranging from 1.0 eV for $Cu_2ZnSnSe_4$ to 1.5 eV for Cu_2ZnSnS_4 and p-type conductivity [1]. This work is devoted to the analysis of CZTSSe thin films structural properties formed by selenization of RF-sputtered Sn, ZnS and Cu stack layers. The precursor films of 800 nm thickness were prepared on SLG and Mo-coated SLG substrates in a sequences Cu/Sn/ZnS/Mo/SLG at room temperature. Series of precursors was prepared, with compositional ratio Cu/(Zn+Sn) varying between 4.0 - 4.5 and S content about 5.5 at. %. Selenization of the precursors was carried out in a tubular furnace in Ar (purity 99.995 %) atmosphere by using 5.5 mg of Sn and 13 mg of Se powder as Se and Sn sources placed in quartz container (volume of ~5 cm^3). Complete characterizations have been performed using X-ray diffraction (XRD), Atomic force microscopy (AFM), Scanning electron microscopy (SEM), Energy dispersive spectroscopy (EDS), Raman spectroscopy (RS), Hall Effect measurement system and Secondary ion mass spectroscopy SIMS). The XRD peaks corresponding to the reflections of atomic planes the (112), (220)/(204) and (132)/(116) of the polycrystalline-kesterite type CZTSSe were clearly observed in XRD patterns. In RS spectra of grown CZTSSe films three main components 172, 194 and 234 cm^{-1} attributed to $Cu_2ZnSnSe_2$ phase were observed. The grains that are larger than 1.0 μm in size was observed by SEM analysis in Cu-rich material, which was well crystallized and dense. The depth profiles of the elements Cu, Zn, Sn, S and Se in CZTSSe absorber layer and diffused sodium concentrations into the CZTSSe absorber layer from SLG substrate were investigated by SIMS analysis in detail.

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CT14

Vanadium nitride thin films grown by high power impulse magnetron sputtering

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[keywords] Reactive sputtering, HiPIMS, vanadium nitride, substrate bias.

Thin vanadium nitride films were grown on SiO2 by reactive high power impulse magnetron sputtering (HiPIMS). The film properties were compared to films grown by conventional dc magnetron sputtering (dcMS) at similar conditions. We explored the influence of the nitrogen partial pressure, stationary magnetic confinement field strength, operating pressure and substrate bias, on the film properties. Structural characterization was carried out using X-ray diffraction and reflection methods as well as pole scan measurement. Our results show that an Ar/N2 mixture with 8/1 ratio is sufficient to grow stoichiometric VN. HiPIMS grown films are denser and have lower surface roughness when grown at low pressure < 1 Pa. The films grown by HiPIMS with strong magnetic confinement exhibit higher density and lower roughness. Lowering the magnetic field strength increases the deposition rate significantly for reactive HiPIMS. The VN film grown at substrate bias of -50 V exhibits the highest density and deposition rate, lowest surface roughness and electrical resistivity. From GiXRD it can be concluded that biased substrate leads to highly (200) textured VN film. Pole scans show that by increasing bias voltage, the angle between the (200) plane and the substrate plane become smaller and for substrate bias of -200 V they become almost parallel. Film composition analyze using electron probe micro (EPMA) analysis shows that by increasing substrate voltage the VN film become more vanadium reach.

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CT15

Surface Morphology Dependent Electrical Instability of ZnO Thin Films Grown by PED Technique

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[keywords] Zinc Oxide (ZnO), Pulsed Electron Deposition (PED), Surface Roughness, Electrical Stability.

Zinc oxide (ZnO), a wide-band gap semiconductor (~3.37 eV at RT) with a large exciton binding energy of ~60 meV, has been an attractive material for developing novel electronic and optoelectronic devices. However, the performance of such devices are hindered greatly due to the lack of control over the electrical conductivity in ZnO thin films subject to ambient conditions. The reactivity of ZnO surface to the atmospheric adsorbates such as oxygen and hydrogen as well as the intrinsic defects such as oxygen vacancies and zinc interstitials have major impact on the electronic properties of ZnO. Previous studies have shown that the surface quality (surface and particle morphology), strain and grain size of the ZnO films can significantly affect the performance and stability of ZnO based devices as well [1-4]. Therefore, understanding the relation between the electrical stability of ZnO thin films and its surface characteristics is of crucial importance to realize high gain ZnO based devices operating under atmospheric environment. In this study, we investigated the interplay between the surface morphology and electrical stability of ZnO thin films grown by PED technique. We demonstrated a controlled growth of ZnO thin films using PED for the accelerating voltages ranging between 12 and 15 kV and analyzed the resultant structural differences such as surface roughness, particle formation, crystallite size and the lattice strain. Four-point van der Pauw and Hall measurements were systematically carried out right after the deposition and a week later to assess the resistivity, carrier density and mobility characteristics of the deposited films. We found that the fluctuations observed in the electrical stability of the samples were originating from the oxygen adsorption on the film's surface which is strongly determined by the total surface area.

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CT16

Efficiency Studies of Magnetron Sputtered Cu_2ZnSnS_4 Thin Film Solar Cells

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[keywords] thin films, CZTS, solar cell.

Cu_2ZnSnS_4 (CZTS) as an absorber layer for thin film solar cells is a good candidate due to its low cost and earth abundant contrary to 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, it is an ideal absorber layer for photovoltaic devices [1]. Besides, CdS is one of the most promising buffer layer for solar cell applications because of its n-type semiconductor characteristic, high band gap energy (in the bulk form E_g=2.42 eV) for thin film solar cells [2] and well lattice match with the heterojunction interface. Although other techniques have been used for the deposition of CdS, chemical bath deposition (CBD) is the best to obtain uniform, adherent, transparent and stoichiometric CdS thin films [3]. The aim of this work is to understand effect of CdS buffer thickness layer on CZTS solar cell efficiency. Two steps process were used to fabricate CZTS absorber layers [4]. Firstly, CZTS metallic precursors were deposited on molybdenum (Mo) coated soda lime glasses (SLG) via DC magnetron sputtering method [5]. This method was allowed to control thickness of the layers [6]. Secondly, all precursors were sulfurized inside a graphite box using sulfur powder under Ar gas atmosphere. CdS buffer layer deposited on CZTS absorber layer using CBD method at 85^{o}C with variety of times (60, 75 and 90 min) in order to form p-n junction. Then, ZnO and Al dopped ZnO (AZO) layers were deposited on CdS to complete solar cell device [8]. Structural characterization of samples was done by using Raman Spectroscopy, XRD and EDX analysis. Furthermore, the surface morphology was determined by SEM analysis. J-V curves were obtained for SLG/Mo/CZTS/CdS/ZnO/AZO solar cell structure. The photovoltaic characteristic of solar cells was studied and dependence on CdS thickness were found [7]. The highest efficiency was obtained for the lowest thickness of CdS. Therefore, buffer layer thickness plays a crucial role for solar cell efficiency.

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CT17

Effect of surface multicrystalline silicon morphology by alkaline and acidic chemical etch texture on QSSPC carrier minority lifetime measurements

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[Keywords]: Multricrystalline silicon, Surface texture, Surface recombination velocity, Carrier minority Lifetime

We have investigated the silicon multicrystalline (Si-mc) surface texture using alkaline and acidic etching chemical processes based on NaOH:H2O and HF: HNO3 respectively and their effect on the effective minority carrier lifetime (τ_{eff}) values measured by quasi steady state photoconductance (QSSPC) setup and the surface recombination velocity (SRV) strength [1]. These two parameters are very critical in silicon solar cell fabrication process and their impact on the electrical performances particularly the open circuit-voltage and the short-circuit current [2]. Scanning electron microscopy (SEM) characterization show a strong alteration of the surface with acidic etch with a low reflectance coefficient comparing to the alkaline etch. The τ_{eff} measured with Iodine-Ethanol (I.E.) passivation solution gives an effective surface velocity around 120 $cm.s^{-1}$. QSSPC measurements of τ_{eff} on alkaline and acidic with receipes1 and 2 give 15, 2.9 and 2.3 µsec respectively (fig.1). This indicates a strong surface recombination activity with acidic etch due to the nature of the obtained surface morphology. The corresponding S_{eff} estimated values vary from 120 to $6x10^3$ $cm.s^{-1}$. The SEM observation of the cross section of the sample with $6x10^3$ $cm.s^{-1}$ high S_{eff} shows a damaged surface containing a high macrospores density (fig.2-b,d). After that, we have deposit a silicon nitride (SiNx) layer rich in hydrogen using a pressure enhanced chemical vapor deposition (PECVD) on the front and rear surface of the wafers which passive the recombination surface centers density [3] and allow an effective recovery of minority carrier lifetime measured values (12.4 µsec) with an S_{eff} = 350 $cm.s^{-1}$.

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CT18

Li Doped Oxide Semiconductors ((Zn,Co)O and (Zn,Co)Ga_2O_4) For Fuel Cells materials

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[keywords] semiconductor, point defect, ionic transportation, solid oxide fuel cell

Solid oxide fuel cells are composed of an electrolyte embedded into two porous electrodes, an anode and a cathode, allowing to pass oxygen ions throughout them. Basically, oxygen atoms are reduced to oxygen ions by gaining electrons at cathode part and diffusion of them takes place until reaching the surface of anode and they react with hydrogen at the end to produce water and hence electricity to the inverse way at circuit.

Using lithium (% 5, % 10 and %20) doped $(Zn_{1-x}Co_x)Ga_2O_4$ (x=0.00, 0.10, 0.20 and 1.00)) nanoparticles as electrolyte materials in solid oxide fuel cells. The nanoparticles will be synthesized using chemical reaction method. The dopand atoms amount will be increased in order to manage the enhance performance of $(Zn_{1-x}Co_x)Ga_2O_4$ particles as electrolyte materials. Furthermore, the homogeneous size distribution and the temperature dependent ionic conductivity, specifying the anode and cathode materials and cycling ability of the fuel cells are the other important parameters in understanding the systematic change in the performance of electrolyte materials [Shawuti, 2014].

In order to use in fuel cells, the both sides of the electrolyte materials will cover with suitable anode and cathode materials. AC Impedance Analyses will be performed to measure the ionic conductivity, activation energy and working temperature of fuel cells. The aim is further analyses of the previous study carried out on ZnO and $ZnGa_2O_4$ semiconductors which are suitable for low temperature solid oxide fuel cell (SOFCs) applications [Shawuti, 2015].

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CT19

High temperature magnetic and synchrotron radiation-based structural study of Fe/Al multilayer

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[keywords]: Intermetallics, FeAl Multilayers, XRD, XRR, TEM, VSM, Synchrotron.

Present work shows in-situ annealing study of interface reaction of Fe/Al multilayer structure (MLS) grown by ion beam sputtering (IBS). The structural studies with respect to thermal annealing were carried out using Synchrotron based grazing incidence x-ray diffraction (GIXRD) and x-ray reflectivity (XRR), at P08, high resolution XRD beamline. In-situ annealing was done in a range from 200°C to 400°C. The structural studies show that (i) the pristine MLS consisted of a thin intermixed layer of FeAl at the interfaces formed at the time of deposition, (ii) growth of FeAl layer with annealing and (ii) finally converted into a single ordered layer of Fe_3Al at higher annealing temperature. The effect of thermal annealing on the interfacial structure of MLS is also investigated by using high resolution transmission electron microscopy (XTEM). The TEM results further confirm the above XRD and XRR results. The magnetization with respect to temperature is recorded using vibrating sample magnetometer (VSM). Coercivity as well as saturation field increases continuously, but the magnetization decreases as a result of annealing. The Curie temperature (T_c) determined from the M-T curve is found to be very less as compared to Fe bulk but much higher than that of room temperature. The magnetization behavior received is largely associated to change in MLS structure, FeAl phase formation and enhancement in anti-ferromagnetic interlayer coupling with respect to thermal annealing.

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CT20

Properties of Si-Li Alloys: A First-Principles Study

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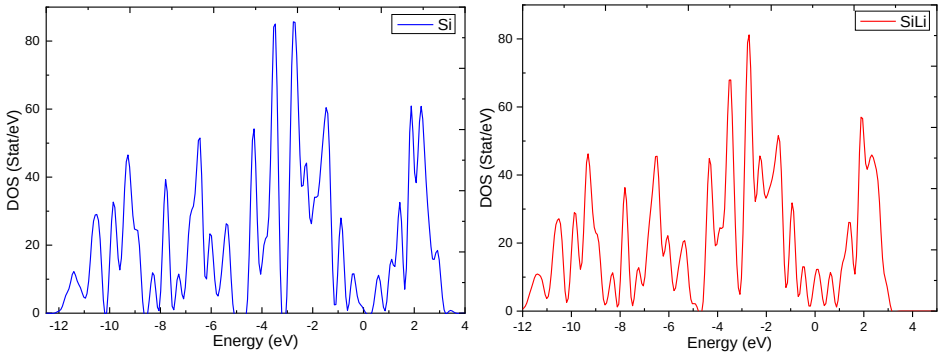
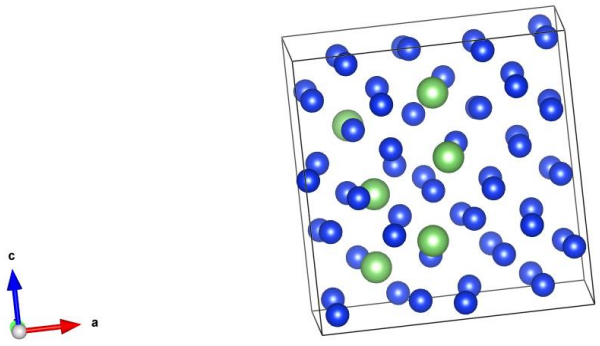
[keywords] Electrical storage, Si-Li alloys, DFT.

In this work, we present the energetics, structure, electronic and mechanical properties of crystalline and amorphous Li-Si alloys. We also investigate the dynamic behavior of the alloys at finite temperatures based on ab initio molecular dynamics. Electronic structure analysis highlights that the charge transfer leads to weakening or breaking of Si -Si bonds with the growing splitting between 3s and 3p states, and accordingly, the Li -Si alloys soften with increasing Li content. These results help us to better understand the physical properties of Si-Li alloys.



We constructed a structure of 64 silicon atoms and silicon vacancies are created where they are filled with lithium atoms of 1 to 6 in different positions of the total structure of the Si-Li alloy. We use the VASP calculation code to simulate the physical properties of our Si-Li structure. After correlating these properties, we determine the percentage pores to be made experimentally in the silicon that we will use as anode to lithium batteries. The pores in the silicon will play a big role in order to avoid the cracking of Si in the process of lithiation/delithiation.



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CT21

Electronic correlations in artificially-synthesized bioinorganic molecules

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[keywords] Bioinorganic molecules, metalloenzymes, metalloproteins, quantum impurity models.

Artificially-synthesized organic molecules which contain transition-metal atoms offer new possibilities for various applications in chemical, electronic and pharmaceutical industries. Examples for such bioinorganic molecules include ruthenium-based dye molecules for solar cells, organic light emitting diodes, molecular switches, and single-atom catalysts. In this context, it is interesting to note that there also exist in nature metalloenzymes and metalloproteins which are organic molecules containing transition-metal atoms. The combined density functional theory (DFT) and quantum Monte Carlo (QMC) calculations have found that impurity bound states (IBS) exist in the electronic structure of the metalloproteins and metalloenzymes. The IBS are the result of the strong electronic correlations. In particular, the electron occupation of the IBS determines the electronic and magnetic properties. The energy value of the IBS is controlled by the underlying molecular structure. We present results from the DFT+QMC calculations on metalloproteins and metalloenzymes to show the role of the IBS. We suggest that, by artificially modifying the molecular structure around the transition metal site, it may be possible to control the energy of IBS and hence, the electronic structure and the functioning of these bioinorganic molecules. This approach may lead to new advances in the design of bioinorganic molecules for various industrial applications.

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CT22

Thermo-mechanical characterizations of polymers thin film for microelectronics applications

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[Keywords]: Polymer film, inverse method for Thermo-elastic properties identification.

In the field of microelectronics, general processing of devices involved multi-layers deposition on a silicon substrate. Usually these are made of metals or oxides but also polymer films. During the processing, successive layers deposition are made at different temperature larger than the room temperature, followed by cooling. They exhibit high coefficients of thermal expansion (CTE), which can lead to some reliability problems for the devices [1]. The general constraint is that planarity needs to be ensured either at the temperature of deposition or at room temperature for subsequent use.

The deformation and essentially the curvature generated by these temperature variations can be predicted by prescribing equilibrium of the overall forces and momentum [2], provided that for each layer the elastic modulus and coefficient of thermal expansion (c.t.e) are known and also the stress related to the deposition. This has already been considered [3] but in our work, the formulation has been extended to take into account the polymer layers for which the thermoelastic properties are temperature dependent. It is then mandatory to identify the elastic modulus and c.t.e. with temperature, in conjunction with the transition temperature between the solid and the viscous states (Glass temperature, Tg) for polymer films. To this end, a methodology is presented, specific to polymer layers for which the thermoelastic properties are known to be different from those of the bulk.

As a case study, we consider a film of polyimide, 3.8 µm thick, used in the microelectronics industry. At the deposition temperature (350°C), the film is viscous and solid at room temperature. The temperature dependence of the elastic modulus is given by DMA (Dynamic Mechanical Analysis) supplemented with "nano DMA" consisting in local nano indentation tests. The results in terms of magnitude of the elastic modulus and their variations with the temperature are discussed together with the value of the transition temperature between the solid and the viscous state. With this identification of the elastic modulus, that of the c.t.e. is carried out. To this end, experimental measurements are made on Si-Polymer bilayer specimen. This technique allows to measure and record the curvature of square samples or circular wafers with temperature variation. With these input data, an inverse method is employed for the identification of the c.t.e variation in both solid and viscous states with temperature by using curvature data and elastic modulus. Our work is validate by the comparison of experimental curvature and predicted one obtain using the determined material properties.

The endeavous allows then to predict the deformation and curvature variation with temperature of multi-layers containing a polymer film, of which thickness can be adjusted to control the planarity at the target temperature, for instance.

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CT23

Active Deep Energy Levels on Gas Sensing Performance of (Zn, Co)Ga_2O_4 thin films

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[keywords] Oxide semiconductors, Gas sensing, renewable energy, hydrogen.

We focus on zinc gallate (Zn,Co)Ga_2O_4 oxide semiconductors, which have limited study on. (Zn,Co)Ga_2O_4 are direct band gap semiconductors with value 4.4 – 4.7 eV (at room temperature), transparent to the visible light and high refractive index materials. The physical properties make (Zn,Co)Ga_2O_4 semiconductors be suitable for applications in solar cells, gas sensors, chemical sensors. The aim of this study is to show the point defects dependent gas (H_2 and O_2) sensing ability above the room temperature and opto electronic behavior of $ZnGa_2O_4$ thin films, fabricated via RF magnetron sputtering system. The sensing ability were performed with temperature dependent I-V and C-V curves. The active energy level of (Zn, Co)Ga_2O_4.to gas sensing were investigated employing DLTS (deep level transition spectrometer) measurements.

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CT24

Atomic layer deposition of metallic oxides for optical fiber sensors fabrication

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[keywords] optical fiber sensors, biosensors, thin film overlays/claddings, atomic layer deposition, long-period gratings, lossy-mode resonance, optical properties, alkali-resistant materials

Novel optical sensors the most often require thin films or surface structures with strictly controlled properties, which play a critical role in the devices, by initiating or modifying their sensorial responses. This paper deals with selected results of research on properties of atomic layer deposited (ALD) metallic oxides, regarding their applicability for thin functional coatings in lossy mode resonance (LMR) and long period grating (LPG) optical fiber sensors. For this study, films of tantalum oxide (Ta_xO_y), zirconium oxide (Zr_xO_y) and hafnium oxide (Hf_xO_y) with thicknesses below 200 nm were deposited at the low temperature (LT) of 100°C. They were basically amorphous. As chemical precursors an appropriate metallic compound - tantalum pentachloride, tetrakis(ethylmethyl) zirconium and tetrakis (ethylmethyl) hafnium, respectively – and deionised water as a source of oxygen were used. Then, the properties (optical, structural, topographical, tribological, hydrophilic, regarding chemical stability) of the films and their technological controllability were critically analysed [1]. Furthermore, the Ta_xO_y as a selected oxide coating was successfully applied in LPG sensor [1]. Thanks to its chemical robustness in alkali environment, with pH at least up to 9, the device gained potential for fabrication of regenerable/reusable biosensor. Additionally, ALD technique was tested as a tool for tailoring sensorial properties of LMR sensors [2]. In particular, the double-layer coatings composed of two different materials were experimentally tested for the first time; the coatings were composed of plasma-enhanced chemical vapour deposited (PECVD) silicon nitride (Si_xN_y) and much thinner ALD Ta_xO_y. That approach yielded operating devices, ensuring fast overlay fabrication and easy tuning of the resonant wavelength at the same time. The LT ALD Ta_xO_y films turned out to be slightly overstoichiometric (with $y/x \sim 2.75$) [3]. The issue of Ta_xO_y chemical composition (stoichiometry and contamination) was studied by secondary ion mass spectroscopy, Rutherford backscattering spectrometry and x-ray photoelectron spectrometry.

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CT25

Fabrication of Mg-doped ZnO thin films by RF magnetron co-sputter method and investigation of photocatalytic activities

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[keywords] Zinc Oxide, Magnesium, Photocatalyst, Ultraviolet, Thin Film, Magnetron Co-Sputter

Photocatalysis has been an outstanding method for efficient degradation of organic contaminants which are harmful for human being and nature. Photocatalyst can be used on powder or thin film form for wastewater applications. Recently, thin film photocatalysts have a lot of promise for future application due to it can easily separate from solutions compared to powder photocatalyst. Various semiconductor metal oxides (TiO_2, ZnO, WO_3 etc.) have been extensively studied as a photocatalyst thin film because of they are photoactivated by ultraviolet (UV) and visible light. Among semiconductor metal oxides, zinc oxide (ZnO) is highly preferred due to its stable structure, high quantum yield, anti-bacterial and eco-friendly nature. Nevertheless, ZnO has narrow band gap energy which limits the using of ZnO as a photocatalyst for practical applications, under high-energy UV light irradiation such as UV-B (320-280nm) or UV-C (280-200nm). Therefore, increasing of band gap energy under high-energy UV light irradiation is crucial for the photocatalytic efficiency of ZnO. Nowadays, element doping is a simple and convenient method to increase the band gap energy allowing the formation of higher energy electron-space pairs which increase the photocatalytic activity [1]. Element doping can also affect the crystal size and surface area which increase the photocatalytic activity. Generally, metals (Al, Cu, Ag, Mg, Mn, Ni, Co) are preferred for element doping because they have the potential to transfer electrons easily and increase the band gap energy [2]. Recently, magnesium (Mg) doping is preferred among other metal dopants because Mg^{2+} (0.57A) and Zn^{2+} (0.60A) have similar ion radius. Thus, Mg can be easily incorporated into the crystal structure during doping. It is also preferred as a doping element because of the low cost of Mg and its harmlessness to the environment [3].

In this study, $Mg_xZn_{1-x}O$ thin films were prepared by RF magnetron co-sputtering method at different thickness and annealing temperatures to investigate the effect of chemical composition and surface morphology on the photocatalytic activity. The surface and crystal properties of prepared thin films were characterized by Scanning electron microscope (SEM), X-ray diffraction analysis (XRD) and Raman spectroscopy. Photocatalytic activity of prepared thin films was measured by UV-Vis spectroscopy with degradation of methylene blue (MB) solution under UV light irradiation. Photocatalytic activity of $Mg_xZn_{1-x}O$ thin films was compared with bare ZnO thin film.

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CT26

Porphyrin Metalation on Ag(111) by Chemical Vapor Deposition of $Ru_3(CO)_{12}$

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[keywords] chemical vapor deposition, porphyrins, surface chemistry, scanning tunneling microscopy

Porphyrin molecules are natural products whose physical and chemical properties depend sensitively on the choice of the metal center. They can accommodate numerous metal ions inside their cavity enabling different applications for molecular electronics [1], sensors [2] and light-harvesting devices [3]. They also play important roles in biological processes such as oxygen transport (heme), oxygen activation (active site in cytochrome P450) and photosystems (magnesium chlorin). Here, we report on chemical vapor deposition (CVD) of triruthenium dodecacarbonyl (Ru3(CO)12) as metal precursor with different porphyrin species: tetraphenylporphyrin, its high temperature derivatives, and porphine on the Ag(111) surface under ultrahigh vacuum conditions. We employed synchrotron radiation X-ray photoelectron spectroscopy, near-edge X-ray absorption fine structure, and scanning tunneling microscopy to understand the CVD metalation process of the porphyrin species, the pertaining molecular conformation and role of the silver surface [4]. The generality of the introduced CVD approach and the metalation process is demonstrated. It was found that under ultra-high vacuum conditions the Ru precursor adsorbs solely on the Ag surface, which decomposes the metal precursor and delivers Ru atoms to the porphyrin macrocycles.

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CT27

The Passivation, Pitting and Uniform Corrosion Behavior Studies of The Electrodeposited Chromium-Nano Diamond Composite Coating on Porous Materials

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[keywords] Nano Composite Coating, SEM, EDS, XRD, AFM.

Nano composite coatings are a new form of materials possessing high hardness, wear and corrosion resistances. In this study, electrolytic coating of pure chromium and Cr-ND (nano diamond) were applied on pre-alloy metal powder metallurgy specimens. The effects of the co-deposited ND particles on passivation, pitting and uniform corrosion behavior of the chromium coatings were investigated. Characterization tests were carried out using an optical microscope, SEM (Scanning Electron Microscope), EDS (Energy Dispersive X-Ray Spectroscopy), XRD (X-Ray Diffraction) and AFM (Atomic Force Microscope). The corrosion behavior of the samples was analyzed by Polarization Resistance, Cyclic Voltammetry and Electrochemical Impedance Spectroscopy measurements under %3.5 wt. NaCl solution. The corrosion resistance of the coated specimens was compared with the non-coated samples. The results demonstrated that the incorporation of the ND particles in the chromium matrix led to a significant improvement in the corrosion behavior of the Cr-ND coatings compared to pure chromium coatings and non-coated specimens.

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CT28

Photocatalytic degradation of azo dye using TiO_2 - modified silicon nanowires as photocatocatalyst

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[Keywords]: Silicon nanowires (SiNWs), Titanium dioxide, Photocatalysis, UV-VIS spectroscopy.

Dyes are an important factor in environmental pollution and their degradations becomes a great concern for the humanity. Recently, the application of semiconductors in heterogeneous photocatalysis to eliminate various dyes in aqueous systems as well as in the air has gained significant attention. Among dyes, the Rhodamine B (RhB) is the most used in the textile industry, biological stain, tracing agent [1-2]. For this reason, we used in the present work the RhB molecule as pollutant to assess the efficiency of realized photocatalysts. We report on the high efficiency of titanium dioxide-modified silicon nanowires for its UV light irradiation. We show that the thickness of the TiO_2 layer deposited by Atomic Layer Deposition technique onto silicon nanowires has appreciable effect on photocatalytic efficiency. The concentration of RhB in aqueous solution was determined using a UV–vis spectrophotometer by monitoring the absorption peak at 555 nm.

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CT29

Electrochemical Impedance Spectroscopy Study of Ti_nO_{2n-1} thin films in basic medium

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[keywords] Titanium suboxide electrode, Magnéli phase, Electrochemical Impedance.

Titanium tends to form many different compounds with oxygen in its crystalline form, such as TiO_2, Ti_2O_3, Ti_3O_5 and Ti_nO_{2n-1} ($4<n<10$) (named Magnéli phase) and it has been commercially recognised under the Ebonex® trade name [1]. The titanium oxide compounds have tremendous potential for application in batteries, fuel cells, cathodic protection, organic solar cells, electronic and optoelectronic devices due to their high electrical conductivity and excellent chemical inertness under aggressive conditions [2]. Ti_nO_{2n-1} films can be prepared by sol–gel, sputtering, plasma spraying, electrochemical deposition, physical vapor deposition and laser chemical vapor deposition [3]. Since it is possible to derive a film using electrochemical deposition method, which is at the desired morphology and thickness, this method is more favorable compared to others. In addition, Electrochemical Impedance Spectroscopy (EIS) is proved to be the most effective electrochemical technique for surface characterization.

The aim of this study, contrary to the studies in the literature, is the electrochemical deposition of Ti_nO_{2n-1} films in basic titanyl sulfate solution on indium-tin-oxide (ITO) electrode without requiring high temperatures. In the previous study, it is shown that the reduction of formed titanium hydroxide hydrate compounds is possible in the acetonitrile [4].

In this work, electrodeposition of films were perfomed at different electrochemical deposition potentials (-1.2V, -1.5V, -1.7V and -2.0V) and electrolysis times (30min, 1h, 2h, 3h and 4h) on ITO electrode. It was detected that different forms of TiO_x (Ti_3O_5 (βTi_3O_5, λTi_3O_5 and γTi_3O_5) and Ti_4O_7) occur on the surface depending on electrolysis potential values. EIS technique was used to determine electrochemical characteristics of the electrodeposited thin films on ITO electrode. The electrochemical measurements showed clear differences in surface properties as a function of deposition potential and time.

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CT30

Optimization of ITO Sputtering Parameters for Deposition onto Polymer Substrate

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[keywords] ITO, magnetron sputtering, radar absorption, transparent conductive coatings

The need for transparent conductive coatings on polymer substrates has produced significant improvements in indium tin oxide (ITO) coating technology in recent years. The polymer substrates have the potential to increase flexibility, enhance damage tolerance as well as, reduce weight and manufacturing costs. However, polymer substrates cannot be heated at high temperatures in contrast to the case for glass, which results in less transparency and conductivity. Thus, sputtering parameters should be optimized for polymer substrates. Both conductivity and transmission through the visible and near infrared can be tailored according to application by tuning the sputtering parameters. In this study, distance between target and substrate, and gas ratio used during sputtering were studied. The structure, morphology and electro-optical characteristics of the ITO coatings onto polymer substrates have been analyzed using X-ray diffraction, atomic force microscopy four-point electrical measurements and spectrophotometry.

CT31

Metamaterial Absorber based Sensor Application in Terahertz Region

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Keywords: metamaterial; absorber, sensor; multiband; terahertz waves.

Metamaterials are artificially designed materials which have their geometric scales smaller than the wavelength of incoming electromagnetic waves. Due to the potential application in imaging, sensing and perfect absorption in terahertz region, metamaterials are taking great interest. Electrical and optical behaviour of these materials are highly dependent to the geometric parameters of the structure (as well as its chemical composition). By altering these geometric parameters, the resonant frequency and the response of metamaterials can easily be tuned.

Metamaterial absorbers can be good candidates in terahertz region for chemical and biological sensing [1-2]. When an unknown material or analyte is added, interaction occurs between this unknown material and the metamaterial absorber. This interaction leads to the frequency shifts in the resonance response. By analyzing these shifts the sensing property can be realized [3].

In this work, a novel multiband metamaterial absorber design is proposed for terahertz regime. The characterization of this absorber is carried out by numerical simulation method. In addition, the utilization of the proposed absorber as a sensor for both dielectric and thickness sensing are also investigated.

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CT32

Self-cleaning glass based on sol-gel coatings

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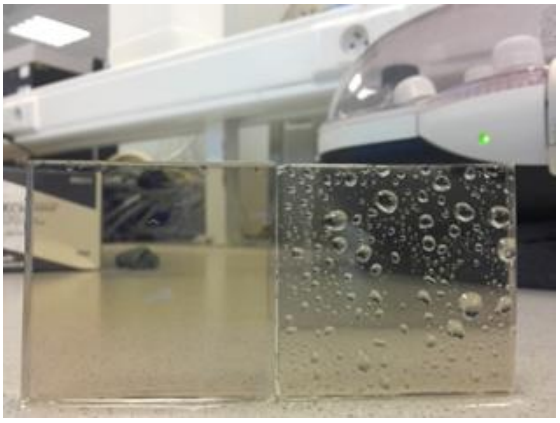
Self-cleaning glass is a special types of glass that needs minimal maintenance because its surface has been designed to keep itself free from dirt and grime. Nanotechnology is used for the fabrication of this special glass in which an ultra-thin coating is applied to achieve the self-cleaning property.



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The goal of the study was to coat glass tiles with nanocomposites materials, to achieve a smooth thin coating with a functional performance, with both photocatalytic and superhydrophilic properties. A fine quality multicomponent nanocoatings was fabricated on the tiles, and a a big number of structural and morphological analysis of the nanocomposites from the synthesis and of the particles on the coating were performed.

We have also studied the aging of the coatings in outdoor exposure in real conditions, in order to follow the evolution of the surface energy and self-cleaning properties.

CT33

Synthesis of $MnCo_2O_4$ nanowires on flexible carbon fiber cloth for high-performance supercapacitors

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[keywords] $MnCo_2O_4$ nanowires, supercapacitor, carbon fiber cloth and hydrothermal method.

Supercapacitors are a new generation of eco-friendly energy storage devices that do not require maintenance and repair, and also have the ability to charge-discharge hundreds of thousands of times, low internal resistance, high power density, extremely long operating life, safe running performance at low/high temperatures [1–3]. In addition to prolonging the life of batteries when used with them, these devices optimize the system size and cost, increase the power efficiency in all electric and hybrid electric vehicles and also address a wide range of applications from renewable energy sources, automotive sector [4,5]. Supercapacitors store energy by means of ion adsorption at the electrode/electrolyte interface (Electric Double Layer Capacitor–EDLC) or by means of rapid and reversible redox reactions (pseudocapacitor) in the vicinity and the surface of the electrode materials. Pseudocapacitors usually offer much higher specific capacitance than supercapacitors made of carbonaceous materials based on double-layer charge storage [6]. Transition metal oxides and hydroxides are the most popular materials for the electrodes of pseudoapacitors because of their high theoretical capacitance, low cost, and low toxicity [7]. However, transition metal oxides with low electrical conductivity reduce electrochemical performance after long charge/discharge processes. For this reason, transition metal oxides in the AB_2 spinel structure (two different transition metals A and B; Co, Mn, Ni, and Zn) with two different metal cation ions as the electrode material are preferred. On the other hand, metal substrate introduces comparable extra weight due to their large mass density, decreasing the actual specific capacitance to a great deal when considering the substrate weight [8]. Carbon fiber cloth (CFC), a network of microsized carbon fibers, has large surface area, high porosity, flexibility, good electric conductivity, low-weight structure and excellent chemical stability in a wide variety of liquid electrolytes [5,6,8,9]. In this work, manganese cobaltite ($MnCo_2O_4$) nanowires are grown homogenously on carbon fiber cloth (CFC) to obtain a binder-free CFC@$MnCo_2O_4$ positive electrode through a simple hydrothermal method followed by calcination.

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CT34

Synthesis and Characterization of Ultra-Long Boron Nanowires with Chemical Vapor Deposition Method

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[keywords] Boron nanowires, CVD, VLS.

Among well-known light elements such as Boron, Carbon and Nitrogen, boron possesses many unique properties. Similarly to carbon and silicon, boron shows an obvious tendency to form covalent molecular compounds, but differs dramatically from carbon in having one less valence electron than the number of valence orbitals. [1]. Boron and it's compounds are semiconductors with electronic properties controlled by icosahedron structures. Since boron and it's compounds are suitable for a variety of applications including high temperature (light) coatings and semiconductor electronic devices, these properties make them attractive in fields such as nanoelectronics, nanophotonics and nanobiosensors [2]. Electrical conductivity of the thin film and bulk form of Boron is low [3], because the band gap of these structures is in semiconductor form. Boron nanowires, like metals, have high electrical conductivity [4] and mechanical strength [5]. Recent interest in boron and one-dimensional (1D) boron nanowires has increased considerably due to their potential applications in nanodevices.

In this study performed using a chemical vapor deposition (CVD) system, 1D boron nanowires were investigated. These nanowires were grown via Vapor–Liquid–Solid (VLS) mechanism according to growth time differences (90, 120 and 180 min.). Structure, morphology and elemental analysis of the boron nanowires were carried out using the X-ray diffractometer technique (PANalytical Empyrean, Cu-Kα, λ=1.54060 Å), a micro raman (WITec alpha300R, λ=532 nm, optical power 30 mW), a X-ray photoelectron spectra (SPECS-Flex, Al-Kα), a field-emission scanning electron microscope (FESEM: FEI Quanta 450 FEG) and an EDS analyzer in the FESEM system (EDAX, AMETEK Materials Analysis Division) respectively.

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CT35

Shellac and Carnauba Wax Based Edible Films Coating for Fruit Applications

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[keywords] Shellac, carnauba wax, surface coating, edible film

An edible film is defined as a thin layer, which can be consumed, coated on a food or placed as barrier between the food and the surrounding environment. Degradation results in processed fruits because of water loss, softening, increased respiration and microbial contamination. For this reason, edible films have a great deal of prominence in fruit surface coatings [1]. When fruit is separated by a barrier, such as a coating or packaging, from exchange of gases with the atmosphere, there is the possibility for respiration to become anaerobic with the associated development of off-flavor [2]. Thus, it is expected that edible film coatings will have certain properties like respiration, antimicrobial activity, water loss prevention. For this study, we selected four coating (FX6-FJ9-FJ7-FX11) treatments with a wide range of barriers to gas exchange, from non-coated control to shellac, a strong barrier coating. These coating products are commercial products that have been stretched in the R & D laboratory of PETRO YAG ve KİMYASALLAR SAN. ve TİC. A.Ş. The effects of coating products were investigated on peach, orange, lemon and apple fruits under the room temperature and fridge storage conditions. In studies on coated and uncoated fruit, moisture content of coating films, water solubility of dry films, antimicrobial activity, and weight loss measurements were investigated. According to the moisture contents of dry films comparison of carnauba wax, shellac and CW-Shellac solutions dry films did not significantly vary from each other. Solubility of dry films in water 42.3; 37.83; 44.9 % for FJ9, FX6, FJ7 and 100% for FX11 respectively. Only FX6 showed antimicrobial activity against Staphylococcus aureus (ATCC 25923) and Escherichia Coli (ATCC 25922). When the weight loss test results are examined, it is determined that different formulas have different effects on the fruits.

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CT36

Determination of anti-corrosion properties of film forming oil soluble boron esters on iron metal by using electrochemical methods

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[keywords] boron ester, film forming, corrosion, electrochemistry

The purpose of this study is to understand corrosion behavior of thin film obtained from oil soluble boron esters, those synthesized and characterized for this study, on iron metal in synthetic sea water by using electrochemical techniques. Weight loss, potentiodynamic and impedance measurements were applied to specimens to obtain their electrochemical characteristics and corrosion behaviors. Surface morphologies were examined by scanning electron microscopy (SEM). All synthesized boron esters were dissolved in Group I base oils at different concentrations (Grup I base oils without boron esters used as blanks) and the metals with 1cm x1cm dimensions coated with this lubricants. After drying in room temperature the weight loss measurements were made in synthetic sea water. According the test results all boron ester containing coated metals showed better anti-corrosion performance than blanks. The electrochemical corrosion tests showed that clear reduction of anodic and cathodic currents shown in potentiodynamic curves and Tafel plots indicate the cathodic reduction (H^1evolution) and the anodic reduction (metal dissolution). The inhibitor molecules are adsorbed onto metal surface, and they decreased the surface area of corrosion by blocking the reaction site of the surface area.

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CT37

Yb/Er - CeO_2 upconversion films on a silicon solar cell

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[keyword: Yb and Er co-doped CeO_2, thin films, up-conversion luminescence, solar cell]

The future needs of green and renewable energy economy require fabrication of highly efficient photovoltaic (PV) devices. Solar energy conversion has shown a significant progress in the last years. Research is focused on rare earth luminescent materials where RE ions are coupled to obtain different conversion properties such as upconversion (UC), downconversion (DC), and downshifting (DS) [1-7].

In our work we have grown upconverting Yb/Er co-doped CeO_2 thin films. Deposition was performed by pulsed laser deposition (PLD) from a bulk target on a p^+-n-n^+ single crystal silicon diode. Target composition was $Ce_{0.95}Yb_{0.04}Er_{0.01}O_2$. The influence of PLD laser fluence on the growth and properties was investigated.

The device with the CeO_2 co-doped film grown for a laser fluence of 2.3 J/cm^2 delivers the highest performance taking advantage of the up conversion (UC) effect provided by this film. The UC mechanism consists of efficient energy transfer between spatially separated Yb^{3+} and Er^{3+} ions, i.e. absorption of infrared light photons by the Yb^{3+} ions ($^2F_{7/2} \rightarrow {}^2F_{5/2}$ transition) is followed by a two-step energy transfer process to neighbouring Er^{3+} ions and by their characteristic luminescent emissions (($^2H_{11/2}$, $^4S_{3/2}$) $\rightarrow$ $^4I_{15/2}$) and ($^4F_{9/2} \rightarrow {}^4I_{15/2}$). The increase in the relative power conversion efficiency of the device is about 12 % and 39 % for illumination under 1 and 2.1 sun, respectively, and its *external quantum efficiency* is 8 % when illuminated with 980 nm light. The film shows also good target-film composition transfer and a granular morphology with a low roughness.

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CT38

Memristive Properties of Er_2O_3 and Er_2O_3:Cu Thin Films on Silicon: HiPIMS application for Cu doping

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Erbium, with unique properties of Er3+ ion, is one of the best material for 1.55μm source used for communication applications. On the other hand, oxide form of Er has a high dielectric constant and has application as a gate insulating material in microelectronics. While researchers are going on memristor era, here we describe Er2O3 based Ti/Er2O3/p++Si and Ti/Er2O3:Cu/p++Si memristor structures which are fabricated and characterised. 50nm thick Er2O3 films are grown on silicon wafers using reactive sputter from metallic target. RF power, Ar, O2 flow rates and base pressure were 60Watt, 35, 0.30 ccm and 5.3x10-3 mTorr, respectively. High power impulse magnetron sputtering (HiPIMS) has proven its potential for improvement of properties of deposited coatings also to be used as doping of thin films with low repetition rates. In this study, synchronously, copper doping is provided by using HiPIMS power source. Copper doping region and density is simply adjusted by selecting the repletion rate and pulse duration. Copper density is kept constant for each growth but location and width adjusted by timing of HiPIMS source during the Er2O3 growth. The current level for undoped Er2O3 based memristors were below pA range for ±5V scanning and hysteretic current voltage character indicates memristive properties exist for Ti/Er2O3/p++Si. High current level and much clear hysteretic behavior observed for Ti/Er2O3:Cu/p++Si. Further details related to Cu doping location and its effect within Er2O3 to be discussed.

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CT39

Recent developments in photoemission (XPS/UPS/ARPES) characterization techniques for nanoscience research

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[keywords] surface analysis, photoelectron spectroscopy, XPS, NAP XPS

Nowadays, the performance of any consumer and industrial technology is restricted by the physical limits of the functional materials employed to achieve a desired physical or chemical effect. Next generation devices and industrial processes are, therefore, often heralded by the elimination of a long standing limit to material performance, or the introduction of a wholly novel material. These advances are, as often as not, driven by new material characterization techniques, enabling scientists to better understand the detrimental physical effects they are trying to eliminate.

Photoelectron spectroscopy has proven to be a powerful tool in this regard, time and time again: it is the only technique that enables direct measurement of a material's electronic structure, revealing elemental concentrations and oxidation states, atomic neighborhoods and charge carrier inducing and reducing mechanisms. Due to its extreme surface sensitivity, the method also allows the direct and indirect characterization of surface effects such as gas adsorption or cluster formation, which are especially interesting in the field of nanoscience due to the high surface to volume ratio of nanomaterials.

Breaking down existing performance barriers also hinges on advancing tried and tested characterization techniques, such as photoelectron spectroscopy. This talk will focus on the recent advances made in this field, specifically the availability of newly developed near-ambient-pressure analyzers and the latest tools to characterize electronic band structures by ARPES, more quickly and easily than ever before.

CT40

Performance of Novel Thermochromic Absorber Coatings for Solar Thermal Collectors

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[keywords] vanadium dioxide, thermochromism, thin films, Ge doping, solar absorptance, thermal emittance, solar thermal collectors.

Traditional solar thermal collectors face the problem of overheating [1]. A smart and novel solution to this problem is the use of switchable absorber coatings, which exhibit a high selectivity at normal operating temperatures and a low selectivity at temperatures exceeding the safe operation limits. The proposed absorbers are based on thermochromic vanadium dioxide thin films. At 68°C, pure VO_2 films undergo a fast and reversible semiconductor-to-metal transition (SMT) [2]. Through the transition, the optical properties change drastically from IR transparent in the low temperature state to opaque to IR radiation at high temperatures. Applied to a highly reflecting substrate such as Al, this translates into a low thermal emittance below and a high thermal emittance above the phase transition temperature. We show that by doping with Ge, the transition temperature of VO_2 is successfully increased from 68°C to ~95°C (~5.9 at.% Ge), which is a considerable improvement for solar thermal applications [3]. Furthermore, Ge doping carries the additional benefit of an even higher thermal emittance of the films in the high temperature state compared to the pure one. At the wavelength of interest of 8 μm, the thermal emittance modulation between the two states is about 10% more in the doped sample.

The full absorber coating consisting of an Al substrate, ~ 300 nm pure or Ge doped VO_2 film, a ~ 20 nm thin $CuCoMnO_x$ spinel-type selective layer and a ~ 40 nm SiO_2 antireflection top coating is deposited by sputtering. We measure the optical properties of the absorbers, containing either a pure or a Ge doped thermochromic layer and calculate their solar absorptance, α_{sol} and thermal emittance, ε_{th} over the 0.4 – 2.5 μm and 2.5 – 14 μm range, respectively. At room temperature, the multilayered absorber containing the pure VO_2 layer shows a solar absorptance, α_{sol} of 94.4%, while ε_{th} is 6.7%. In the absorber with the Ge doped thermochromic layer the α_{sol} is calculated to be 93.7% and the ε_{th} is 8.7%. Heating the absorbers to 100°C, above the transition temperature of the thermochromic layer, the ε_{th} of the pure film increases to 37.3%, while that of the Ge doped film reaches 41.9%.

The determined α_{sol} and ε_{th} are, therefore, remarkable, being competitive with those of currently marketed absorbers, all while offering the significant advantage of a smart thermal control through its integrated thermochromic function.

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CT41

Enhancements on Transport Properties of HgBaCaCuO (Hg-1223) Superconducting Thin Films by Pre-Coating and Quadruple Heat Treatment

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[keywords] (Hg-1223) superconducting thin films, HTS superconducting thin films

After finding superconductivity in Hg-based systems in 1988, important studies have been carried out on this material both in thin/thick film, in bulk and in wire/tape forms. Today, technological applications are also being carried out on this material and significant developments are taking place. Especially for thin film applications, important outputs have been obtained and results obtained are found to be very promising.

In this work approximately 750 nm thick epitaxial *c*-axis orientated $HgBa_2Ca_2Cu_3O_x$ superconducting films have been prepared on MgO(100) substrates using dc magnetron sputtering and pre-coating of the substrates by Hg and a quadripartite post-annealing process. The effects of the pre-coating and a quadripartite post-annealing process combination and the filling factor of Hg *(*ffHg*)* on the physical, transport and magnetic properties of the thin films have been investigated. The XRD investigations showed that the *a–b* plane of the Hg-1223 phase aligns parallel to the substrate surface. The best T_c and T_{zero} were found to be 130.1 and 129.1 K, respectively for the sample pre-coating by Hg. Magnetic properties up to 9 T have been investigated. The calculated value of critical current density, J_c^{mag}, was found to be 8.86 x 10^6 A cm^{-2} and 4.42 x 10^6 A cm^{-2} at 10 K and 77 K respectively at 5 T of applied field. The best results obtained for J_c^{tran} was found to be 2.22 x 10^6 A cm^{-2} at 10 K and 5 T. suggested that pre-coating of substrates with Hg and a quadripartite post-annealing process could be an alternative processing method for Hg-1223 thin film superconductors fabrication.

CT42

The influence of template composition on the stimuli-responsive properties of Nb_2O_5-based Bragg stacks

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Bragg stacks, mesoporous materials, Nb_2O_5, thin films, VOC

Bragg stacks could be constructed by depositing thin films having high and low refractive indices in alternating manner, so that an incident light on the stack exhibits constructive interference that results in high reflectance band generation. This band is sensitive to any change in the optical parameters of the films, which makes them suitable for optical sensing applications. Introducing porosity in dense films effectively lowers their refractive index and so Bragg stack could be engineered by dense/porous thin films from the same material which is considerable advantage.

In this study we have been investigating the influence of polymer structure on the optical properties of Nb_2O_5 thin films when being converted from dense to mesoporous film by soft-template method with templates that are commercially available copolymers (Pluronic). They consist of PPO and PEO blocks and differ by the ratio between those blocks and the molar mass of the PPO in the molecule. The structure of deposited films has been investigated by TEM. The film density and thickness have been calculated using X-ray reflectometry (XRR), while refractive index and extinction coefficient and their changes upon exposure to probe molecules (acetone vapors in our case) have been calculated from ellipsometric measurements using appropriate dispersion models. The porosity introduced into the films has been calculated using Bruggeman effective medium approximation and compared to film density obtained by XRR measurements. The porous films with the most suitable properties have been incorporated in Bragg stack and its stimuli responsive behavior has been demonstrated by reflectance measurements prior to and after exposure to Volatile Organic Compounds (VOC's). The application of dense/porous Bragg stacks as optical sensors for VOC's has been demonstrated and discussed.

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CT43

Critical aspects of the processing of the high power and high voltage AlGaN/GaN HEMTs on silicon substrates

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[keywords] AlGaN/GaN-on-Si, HEMT, high electron mobility transistor, power electronics

AlGaN/GaN-on-Si HEMTs are very promising devices as the components of power electronic systems. To realize high yield mass production of high power and high voltage AlGaN/GaN-on-Si HEMTs several technological challenges must be overcome including developement of CMOS-compatible processes such as Au-free metallization for gate and ohmic contacts or defining of high aspect ratio mulifinger structures. In this work both theoretical predictions and the results of our experimental work on technology of high voltage (HV) AlGaN/GaN-on-Si HEMTs with multifinger structures (up to 40×1mm gate width, see Fig.1) will be presented.

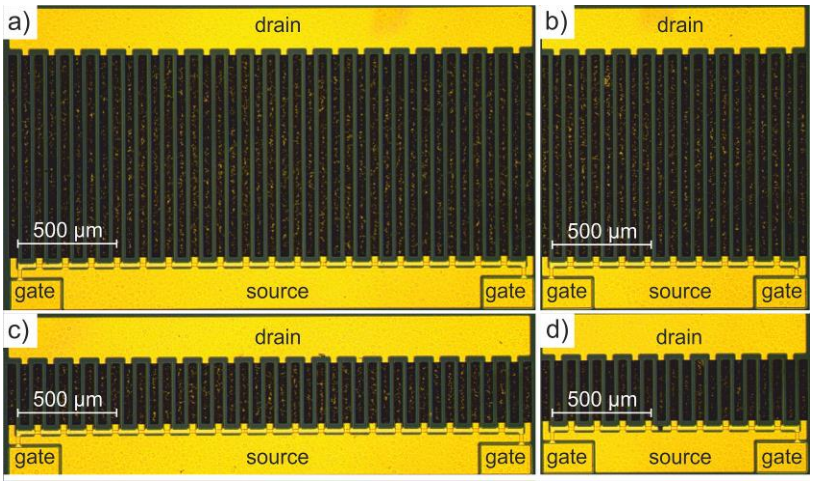

Fig.1 Optical microscopy images of fabricated large periphery multifinger AlGaN/GaN-on-Si HEMTs with a) 40x1mm b) 20x1mm c) 40x0.3mm and d) 20x0.3mm gate width.

The focus will be put on technological conditions that allow to obtain Au-free ohmic contacts as well as the ion implanation processes, used for electrical isolation of adjacent devices and for selective fabrication of highy doped n-type regions for low resistivity ohmic contacts. The results of development of dielectric layers technology for metal-insulator-semiconductor structures and passivation layers will also be presented. We will also show the effect of various pretreatment strategies before gate metallization deposition on electrical parameters of multifinger devices.

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CT44

Investigation of Bacterial Adhesion to Plasma-Modified Polypropylene Surface

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[keywords] Surface modification, RF plasma discharge, bacterial adhesion, polypropylene.

Capacitively coupled Radio frequency (RF) discharge treatment is a highly preferred technique for the surface modification of polymers since it does not change the overall bulk properties and provides a good control over the gas chemistry [1]. The plasma modification effectively improves the poor polymer surface properties by allowing the formation of additional functional groups such as carbonyl, carboxyl, hydroxyl, and amine to the surface. This technique is used for various applications mostly in textile, automotive, packaging, electronic, and biological industries. Most importantly, crosslinking structures generated due to the free radicals provide excellent biocompatibility by allowing a higher concentration of active molecules on the polymer surface [2].

Our previous studies show that the RF discharge significantly improves the wettability of polymers such as polyethylene, polystyrene, poly(ethylene terephthalate), and polypropylene after the plasma exposure [3, 4]. In this study, we are investigating bacterial adhesion to the RF plasma-modified polypropylene surface. The plasma-modified surfaces are chemically characterized using an X-ray photoelectron spectroscopy and a Fourier transform infrared-attenuated total reflection spectroscopy. The wettability is evaluated by measuring the water contact angle. Bacterial adhesion is analyzed measuring the cell population attached to the surface. Moreover, changes in the surface morphology and the bacterial adhesion property are investigated using a scanning electron microscope. The surface modification effects of Nitrogen and Oxygen plasmas are investigated separately for various RF input power values, gas flow rates, and the plasma exposure time intervals in detail.

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CT45

Ab initio study of hydrogen storage in $Mg_{1-x}Al_x$ and $Mg_{1-x}Y_x$ alloys

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[keywords] Hydrogen storage, Mg, DFT.

The Hydrogen storage materials have attracted intensive attention in the future hydrogen economy. Among numerous hydrogen storage materials, Mg and Mg based materials have attracted great attention due to its low cost, lightweight and high capacity (7.6 wt% of hydrogen). Therefore, Hydrogen storage in these materials has been the subject of an intense research effort during the last decades. However, in order to improve the quality of system for hydrogen storage, a variety of alloying elements have been explored. This study reports the use $Mg_{1-x}Al_x$ and $Mg_{1-x}Y_x$ alloys as hydrogen storage using density functional theory (DFT) calculation method. We try to identify the hydrogen behavior in Mg and $Mg_{1-x}Al_x$ and $Mg_{1-x}Y_x$ systems by electronic structure calculations.

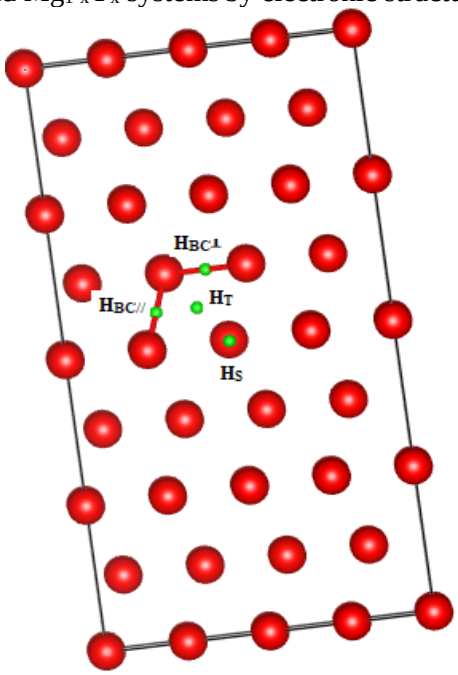

Figure: Location of H impurity in Mg lattice. Mg atoms in red color and H atoms are in green.

The results indicate that the lowest formation energy is that of the T and BC$^{\perp}$ sites with -1.41 eV. These values indicate that, in Mg lattice, hydrogen prefers to localize in tetrahedral site and bond center site that is not parallel to c axis. The effects of hydrogen on structural, electronic, magnetic and optical properties of $Mg_{1-x}Al_x$ and $Mg_{1-x}Y_x$ are discussed.

CT46

Friction and Wear Properties of Nb-V-C-N Coatings on AISI 4140 Steel by Thermo-Reactive Deposition

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[keywords] Wear, Thermo-Reactive Deposition, Niobium Vanadium Carbonitride Coatings.

The thermo-reactive deposition (TRD) technique is an effective method for obtaining hard coatings that are resistant to wear on the surface of the steel. In this study, Nb-C-N, V-C-N, and Nb-V-C-N based hard coatings were obtained on AISI 4140 steel and dry friction and wear properties were compared. Cylindrical shaped AISI 4140 steel samples were first subjected to nitriding in order to have a nitrogen-rich surface. Subsequently, the TRD coating process was carried out at 1000 ° C for 4 hours with pack cementation technique for all compositions. Wear tests of samples; using the ball-on-disc method and using a 10 mm diameter alumina ball as a counter at a speed of 0.1 m/s, for a distance of 250 m, at loads of 2.5, 5 and 10 N and at atmospheric conditions. From the test results, the friction coefficient - distance graphs for the different loads of the coatings were obtained and the friction coefficients were determined. The depths of the traces formed on the surface of the samples were measured by 2D profilometer and the wear rates were calculated. Wear traces were investigated using scanning electron microscopy (SEM) and energy dispersive X-ray spectroscopy (EDS) and the wear mechanisms were evaluated.

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CT47

Investigation of the protective iridium-based coatings using MOCVD with [Ir(cod)Cp^{x}] precursors

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[keywords] Iridium coatings, precursors for vapor-phase deposition, cyclopentadienyl Ir complexes.

Metal-Organic Chemical Vapor Deposition (MOCVD) is one of the most promising technique to produce coatings from refractory metals (or their oxides). Among such materials iridium based coatings have found a broad range of applications which include their usage as corrosion-preventive and antioxidative coatings [1, 2] or highly stable electrocatalysts [3]. The properties of the produced coating are strongly depend on the chosen precursor, or rather its thermochemical properties and the conditions of MOCVD process. So the developing of the MOCVD method is closely related to the expanding the range of precursors to satisfy any requirements of the MOCVD process and detailed analysis of the experiment conditions influence on the characteristics of obtained coating.

This work is focused on studying iridium based thin films obtained by MOCVD as perspective protective coatings for example for the protection of combustion chambers in engines and turbine blades or in the developing of highly stable water oxidation electrodes. Complexes [Ir(cod)Cp^{X}] (Cod – 1,5-cyclooctadiene; Cp^{X} – alkyl substituted cyclopentadienyl) were used as the precursors.

The influence of MOCVD experiment conditions (deposition and evaporation temperature, flow rates of the carrier gas and reagent gas, etc) on the morphology and structure of the resulting coatings was investigated. Considering the high cost of iridium special attention was paid to the search for the deposition temperature range in which the most effective use of the precursor occurs. The interval is 320-380°C for [Ir(cod)Cp^{Et}] and 260-320°C for [Ir(cod)Cp*]. Iridium coatings were obtained on Si(100) and analysed by SEM, EDX, XRD and XPS. Based on the data obtained, coatings up to 10 microns thick were obtained. Such a thickness is sufficient to use these samples as models of protective coatings for gas turbine blades.

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CT48

Investigation of mechanical and tribological properties of BCN thin films

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[keywords] CFUMBS, BCN, Friction, Wear, Critical load

BCN thin films are one of the most attractive materials in recent years based on their high hardness values [1], and excellent tribological properties [2]. Having such characteristics, BCN films are becoming crucial for industrial and scientific applications as protective coatings. BCN films are also being used as lubricating coatings for high temperature applications due to good thermal and chemical stabilities. Several different deposition techniques have been carried out successfully such as chemical vapor deposition [3], rf-magnetron sputtering [4], reactive magnetron sputtering [5], dc-magnetron sputtering [6], closed-field unbalanced magnetron sputtering (CFUMBS) [7] and high-power impulse magnetron sputtering (HiPIMS) [1]. In this work, BCN films were deposited on 4140 steel substrates by a superimposed closed-field unbalanced and high-power impulse magnetron sputtering system using different deposition parameters. The structural, mechanical and tribological properties of BCN films were investigated. The structural properties of the BCN films were characterized by XRD and SEM techniques. Mechanical properties of the BCN films were determined by micro-hardness and scratch tester. Tribological properties such as friction and wear of the films were carried out by pin-on-disc tribometer under atmospheric conditions. The maximum hardness and friction coefficient has obtained as 18 GPa and 0.54, respectively. The results showed that the hardness values affected the friction coefficient negatively due to the hard abrasive particles.

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CT49

Berezinskii-Kosterlitz-Thouless Transition in Superconducting Nb Films with Kagomé Arrays of Antidots

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Keywords: Superconducting Nb films, Kagome lattice, Vortex-antivortex binding/unbinding, BKT transition.

The resistive phase transition in 2D superconducting Nb films with kagomé arrays of antidots was explained in the frame work of Berezinskii-Kosterlitz-Thouless (BKT) transition. For these complex nano-structure metallic films, the temperature dependencies of the resistance can be explained by the Halperin-Nelson form suggesting the occurrence of BKT transition at lower temperatures. It was observed that the resistivity data, both with and without magnetic field were consistent with BKT transition. The broadening of resistive transition at H/H1= ½ and the increase of zero resistivity critical temperature $\{T_c(R = 0)\}$ at H = 1 rather than at H = 0 was reminiscent of vortex-antivortex dissociation transition (i.e. BKT transition) in these samples. The strong broadening of resistive transition and enhanced magneto-resistance at H/H1= ½ was concomitant with strong magnetic fluctuations (i.e. binding and unbinding of vortex-antivortex) due to frustration and localization mechanisms induced by highly degenerate ground states in these 2D periodic structure samples.

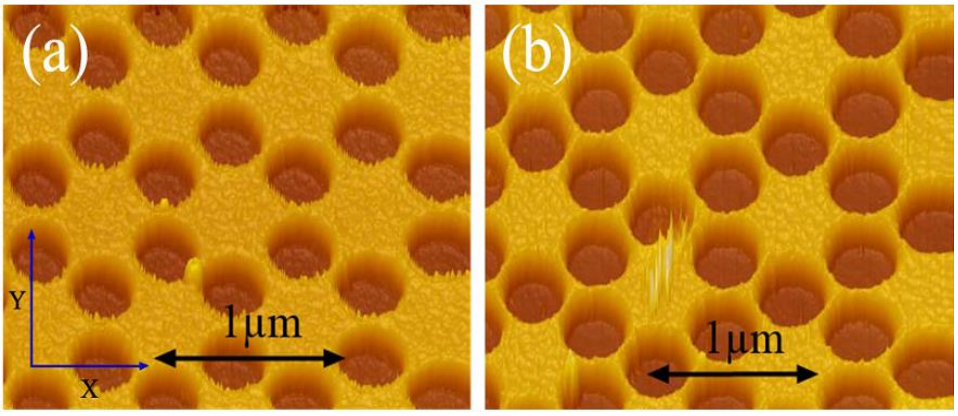

Fig. (a, b): Atomic force micrographs (AFM) of superconducting Nb films with (a) honeycomb and (b) kagom´e array of holes.

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Superconducting Properties of Bi-2212 thin films produced by Pulsed Laser Deposition

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In view of applications, it is highly desirable that the superconducting material has a stable single phase. The Bi-2212 phase has a much better stability compared to other phases of the same compound; hence, it makes it advantageous for applications. In this study, Bi2Sr2Ca1Cu2O8+∂ thin films were deposited on MgO (100) substrates by pulsed laser deposition (PLD). The effects of post-annealing temperature and time on the phase formation, the structural and superconducting properties of the films have been investigated by means of X-ray diffraction (XRD), scanning electron microscopy (SEM), temperature dependent resistivity (R–T), and DC magnetization measurements. The films deposited at 600oC were post-annealed in an atmosphere of a gas mixture of Ar (%93) and O2 (%7), at temperatures ranging between 800 and 880. An optimum temperature of 860 oC was found for the post-annealing thermal treatment. The critical temperature, TC, of the films was measured as 82 K and the critical current density, JC, was calculated as 3x107 A/cm2 for the film annealed at 860 oC. In order to investigate the post annealing time effects, then the films having the best superconducting properties were kept at 860oC for 10, 30, and 60 minutes. All films have demonstrated a mainly single phase of Bi-2212 with a high crystallinity (FWHM ≈ 0.16o) and c-axis oriented. The critical temperature, TC, of the films annealed for 10, 30, and 60 minutes were obtained as 77, 78, and 78 K, respectively. It is observed that while the annealing time increases, the area of hysteresis loops remarkably becomes larger. This is attributed to the fact that an increase of the annealing time leads to a stronger grain structure, stemming from a better crystallization process taking place. By using the Bean's critical state model, the highest critical current density, JC, was calculated as 3,34x107 A/cm2 for the film annealed at 860oC for 30 min. From AFM results, it is observed that the roughness profile under the selected line demonstrates that the heights of the steps chance in the unit cell level of the Bi-2212 phase. It can also be seen that, entirely grain structures of Bi-2212 formed in the main matrices.

CT51

Bonding of quantum cascade lasers by in-situ PVD deposition techniques for terahertz applications

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[keywords]: Terahertz, Quantum Cascade Lasers.

Terahertz (THz) frequency range (0.1-10 THz, $\lambda \approx 0.03$-3 mm) known with many potential applications such as detection of chemical and biological substances, medical and safety applications, astrophysics, remote sensing and monitoring. Quantum Cascade lasers (QCL), are one of the Terahertz sources of radiation, as the longest wave length semiconductor laser sources that working frequencies corresponding to 1.2-5 THz that play an important role [1,2]. The QCL is made up in periodic array of layers shaped with different band spacing to create a multi-quantum well structure. Each period includes many layers which at each stage, the electron-hole zone contains an active region that cause to optical emission occurs. During this procedure by using advanced material systems such as GaAs, a wide range of frequencies can be obtained from QCL with a suitable design. Secondly, thanks to the stepped structure, more than one photon emission per electron can be obtained and greatly increases the optical power of these lasers[3,4]. In this study, metal-metal layer bonding system was designed and prepared for in-situ conditions with magnetron sputtering and thermal evaporation techniques, so that all the metal layers, (Ta) and (Cu) are coated as GaAs and bonded together by applying mechanical pressure under high vacuum state (10^{-6} torr), in 450 ◦ C and about 40 N of mechanical pressure during 60 min. After process complete, we have this structure with GaAs play role as both receptor and holder substrates in addition hand Tantalum layer at maximum 30 nm of thickness. The tantalum layer provide a good joining ability between Cu and GaAs layers also play an active region roll inside the structure. As we seen a good compatibility occurred between two layers of copper and a homogenous junction layer appears.

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Direct Writing by Electrospun Nanofibers

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[Keywords] Electrospun Nanofibers, Direct Writing, Magnetron Sputtering

Most of the lithography techniques to create a pattern on nanoscale devices by using mask are expensive and complicated. Hence seeking a low-cost method to pattern devices without any requirement of the mask and other advanced facilities is the aim of developing new manufacturing techniques. In this research, the electrospun nanofibers have been used to perform direct writing on substrates at the nanoscale level. To achieve this, nanofibers were produced by near-field electrospinning (NEFS) technique and written directly on the substrate under control of the x-y platform. The characteristics of nanofibers play an important role for the continuity and uniformity of the structures. The main factors affecting the size, continuity, and shape of the nanofibers are viscosity, concentration, conductivity and surface tension of the solution. Electrospinning setup includes precisely controlled platform, injector pump, high voltage supplier, and a camera. Polyethylene oxide solution was prepared in different concentrations. Viscosity tests of the polymer solutions were performed with a rheometer. Several parameters were optimized by electrospinning directly on the substrate. The most important factors affecting on the nanofiber patterning are i) applied voltage, ii) distance between the needle and the collector, iii) velocity of the stage, iv) concentration, viscosity and surface tension of the solution, v) flow rate of injector, and vi) temperature of the substrate. After controlling and optimizing all these variables, the nanofibers had the diameter between 200 and 300 nm. Firstly, the glass substrate was coated with 10 nm chromium and 100 nm gold, respectively, by magnetron sputtering technique. The nanofibers were directly written with a pattern and the uncovered areas were etched by reactive ion etching. Finally, the nanofibers were stripped off and electrode arrays were obtained. The morphology of electrode arrays were investigated by atomic force microscopy and the structures of the nanofibers were examined by scanning electron microscopy.

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CT53

Optimization of Zinc Oxide Based Metal-Semiconductor Junction Interface Properties for Optoelectronic Device Applications

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[keywords] Schottky Junctions, ZnO, Functional Materials

Oxide semiconductors are a fairly new addition to functional electronic devices dominated by the established silicon technology. Being both optically transparent and electrically conductive, their unique properties spurred diverse applications such as displays, solar cells and LEDs. Zinc oxide (ZnO) is a Group II-VI compound oxide semiconductor which drew the attention of researchers for possible applications in science and industry. It has a wide, direct band gap of 3.36 eV at room temperature and a large exciton binding energy of 60 meV [1]. The band gap of ZnO can be tuned by forming alloys and impurity incorporation. Therefore, ZnO in the forms of quantum- and nano-structures has received considerable interest and has been recognized as a promising material candidate for making efficient UV/blue light-emitting diodes, sensors, photo detectors, and laser diodes[2,3].

As in the case of all functional electronic devices, fabrication requires interfacing of metals, semiconductors, and insulators in a coherent manner. Metal-semiconductor junction interfaces especially play a prominent role in the device behavior owing to their linear or rectifying characteristics. As a result, linear ohmic and rectifying Schottky junctions are integral to the intended operation of all electronics [4].

In this study; we will present the opto-electronic characteristics of ZnO based thin films in situ doped with Al, Ga, Mg and N, tailored for functional optoelectronic devices fabricated via RF magnetron sputtering technique on substrates decorated with metallic interdigitated electrodes . Fabrication parameters determining the junction behavior such as temperature, gas pressure, power, target-substrate distance, film thickness, encapsulation layer, doping type and amount, etc. were investigated and optimized for metal-semiconductor-metal photodetector designs. Those devices are expected to harvest photo-generated carriers under illumination, taking advantage of the unique properties of Schottky barrier formed at the interface of metallic electrodes and ZnO.

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The photoresponse characteristics of PED grown ZnO thin films

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[keywords] Zinc oxide, UV photodetector, pulsed electron deposition.

Zinc oxide (ZnO) is an II-VI group direct wide bandgap (Eg ~3.37 eV at 300 K) compound semiconductor with a large exciton binding energy (60 meV, 2.4 times larger than GaN, another wide bandgap semiconductor ~3.4 eV), attracting this material for optoelectronic applications. It is a natural n-type semiconductor with hexagonal wurtzite crystal structure [1]. Its excellent optical properties makes it a potential material for numerous optoelectronic device applications, especially operating in the near UV range. There have been used a variety of methods to produce ZnO thin films such as RF magnetron sputtering, molecular beam epitaxy and pulsed laser deposition (PLD). Recently, pulsed electron deposition (PED) method has been considered as an alternative to PLD due to high costs of laser sources and safety requirements of PLD [2,3]. In PED method, instead of photons, highly energetic electrons are focused to the surface of ceramic target to ablate material has even large bandgap energy. Thus, PED method is suitable for growing complex oxide thin films and it could be a good alternative to PLD.

In this work, we have investigated the photoresponse properties of PED grown ZnO thin film both in air and vacuum. The photoresponse of ZnO thin films in the air and vacuum showed very interesting differences. It has seen that the photoconduction process is governed by adsorption/desorption of atmospheric adsorbates such as oxygen and water vapor as well as photogeneration/recombination of excitons. Therefore, we will discuss the different photoconduction process of ZnO thin films both in air and vacuum conditions in this study.

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CT55

Terahertz Imaging Applications and Characterization of ITO Thin Films Grown by Magnetron Sputtering

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[Keyword]: THz imaging, ITO, Electro-annealing

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.

Designed continuous wave THz imaging system consist of Synthesizer 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^{o} parabolic mirrors, room temperature detector "Golay Cell", and XY scanning stage. The beam diameter was determined by knife-edge method and we found it 1.7 mm. It is also compatible with the calculated value "1.66 mm". THz imaging applications were performed by this system such as imaging of leaf, metals, concealed objects and so on.

Indium tin oxide (ITO) thin film is one of the most commonly used materials among the Transparent conducting oxides (TCOs) 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 [2,3]. As I emphasized before, today, terahertz (THz) technology is a heated topic [4]. However, the research on the THz properties of ITO film is currently at an early stage, with relatively few studies on its application in the THz field.

In this work, all the ITO films were grown on the Fused Silica substrates using a DC magnetron sputtering which has heated sample holder at 250 °C. Three ITO film sets with different thicknesses were depeosited by heated the substrates and 1 set of substrates depeosited without heating.

Resistivity of the ITO film is mainly affected by the thickness and heating. Moreover, THz transmission of the ITO film is mainly affected by the conductivity. By changing the thickness of ITO films and Appling Electro-annealing process [5], the terahertz optical performance, Visible light transmittance and electrical properties of ITO films were investigated.

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CT56

Polydopamine mediated growth of Ag nanostructures on ZnO thin films

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[keywords] ZnO thin films, functional surfaces , plasmonics, catalysis .

Nanoengineering the surface of solid substrates offer great promise for use in a range of applications including electronics [1], photonics [2], energy storage [3], sensors [4] and biotechnology [5]. A particular interest is fabrication of multi-functional surfaces through integration of different forms and compositions of materials. In this study, a multi-functional surface was fabricated by decoration of sputter-deposited films of ZnO with plasmonic Ag nanostructures (NSs). Surface growth of Ag NSs was performed by functionalization of the ZnO thin film with mussel-inspired polydopamine.The effect of growth conditions on the size and structure of Ag NSs was studied via SEM imaging. The fabricated multi-functional surfaces exhibited high levels of catalytic and plasmonic activity. The catalytic properties of these NSs were investigated by monitoring the degradation of the methylene orange. In addition, surface enhanced Raman scattering (SERS) properties were investigated by Raman spectroscopy to investigate the plasmonic properties of the NSs as known hot spots.

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CT57

Enhancement of Photocatalytic Activity by Metal Doping on TiO_2 Thin Film

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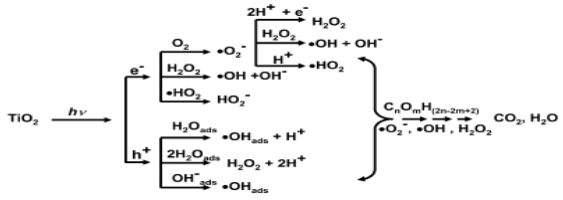
[keywords] Photocatalytic Activity, Titanium Dioxide, Thin Film, Semiconductor.

Titanium (IV) oxide or titania (TiO_2) is one of the most common materials for a variety of applications such as catalytic devices, sensors, solar cells, and other optoelectronic devices. TiO_2 is a wide bandgap semiconductor with many interesting properties, including transparency to visible light, high refractive index and low absorption coefficient. Other than these properties, it has been known to be an excellent catalyst in the field of photocatalytic decomposition of organic materials. This work focus on TiO_2 thin films doped with different metals will be prepared using reactive magnetron sputtering technique. And then, they will be heat-treated to form TiO_2 phase at 600°C for 2 hours in air to obtain anatase phase of TiO_2 [1]. The photodegradation process is shown in this Graph 1. Electron-Hole pairs (e-, h+) are produced when the semiconductor photocatalyst is irradiated by sun light where the energy is higher than the band-gap energy of the semiconductor particles. Then the electrons are reduced from protons to hydrogen and holes are oxidized from H_2O to O_2. These water splitting reactions are generated reactive O_2 species and ·OH radicals which have strong oxidation ability to degrade toxic organic pollutants [2]. The surface structure morphology and composition of films will examine by Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM), X-ray Diffraction (XRD), X-ray Photoelectron Spectroscopy (XPS). The photocatalyctic properties of doped TiO_2 will be investigated from adsorption behavior of them. Methylene Blue will be used as a model organic pollutant.



Graph 1. Chain of reactions involved in the production of reactive oxygen species such as H_2O_2, ·O $^{-2}$, etc. and hydroxyl radical ·OH shown illustratively [2].

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POSTER SESSION A

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PA01

Kinetics of Deposition and Microstructure of PbTe Films Prepared on Si and BaF_2 Substrates by Modified HWE Technique

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[keywords] lead telluride, infrared optoelectronics, microstructure, deposition

For many years the single crystals and thin films of lead telluride and its solid solutions are studied owing to two main reasons [1 – 3]. First, PbTe and $Pb_{1-x}Sn_xTe$ are capable to effectively detect the infrared (IR) radiation in the wavelength range 3 – 25 μm [4]. Second, due to the unique combination of the optimal dielectric permittivity, Seebeck coefficient, and high thermal conductivity, PbTe is a promising material for the manufacture of high-performance intermediate-temperature thermoelectric devices, especially for waste heat conversion into electrical energy [1, 5]. Nevertheless, an application of PbTe-based thin films and nanostructures is still limited by the dependence of device functional parameters not only on the preparation method but also on its structural perfection [4].

The main purpose of this work is to examine the correlation between the average deposition rate and microstructure of PbTe thin films fabricated by modified "hot wall" epitaxy (HWE) under identical process conditions on Si (100) and BaF_2 (100) substrates.

XRD, EPMA, and SEM results have demonstrated that regardless of the substrate nature the average deposition rate of PbTe films having the component ratio within the homogeneity region depended upon the substrate temperature and the component partial pressure values. As the substrate temperature is constant, the average deposition rate $\overline{v}$ raise with increase in Pd vapour partial pressure and with decrease in Te vapour partial pressure values. It has been found that PbTe film average deposition rate was considerably higher for Si (100) substrates than for BaF_2 (100) ones. RHEED results have indicated that the texture of PbTe films on Si (100) wafers corresponded to the substrate orientation and misorientation angle of the mosaic blocks did not exceed 20 degrees. On BaF_2 (100) substrates the epitaxial PbTe film deposition with the orientation relationship (100), [011] PbTe || (100), [011] BaF_2 has been observed.

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PA02

Co-doped ZnO Thin Film Nanocomposites as Model Nanocatalysts

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Keywords: Co: ZnO / Al_2O_3 nanocomposites, thin film nanocatalysts, pulsed electron beam ablation, Fischer-Tropsch synthesis.

Zinc oxide doped with hexagonal close-packed (hcp) Co phase is of particular interest as a model nano-catalyst in many important chemical processes such as Fischer-Tropsch synthesis (FTS) among others [1]. The properties of nano-catalysts depend on particle size, structure, and the presence of the metal in elemental form, so that the control of these aspects during film growth is of primary importance to achieve desirable catalytic features [2]. In this work, we report on the deposition of Co-doped ZnO (CZO) thin films on c-sapphire substrate using the relatively novel pulsed electron beam ablation (PEBA) method at different substrate temperatures (450ºC, 600ºC, 800ºC) and under argon pressure of ~3 mTorr. The formation of nano-particles, which can be exploited for many practical applications including nano-catalysis, is a characteristic feature of PEBA grown films [3]. Three main aspects of the films, viz., size of nanoparticles, presence of elemental cobalt and cobalt crystal phase have been assessed using complementary analytical techniques. Scanning electron microscopy (SEM) has revealed that the films consist of cobalt-rich globules dispersed over the surface, which grow from many primitive nano-particulates with an average size in the range of 10-16 nm. Film roughness, based on atomic force microscopy (AFM) measurements, increases drastically as the temperature is increased, viz., nearly 5 nm (450ºC), 19 nm (600ºC), and 18 nm (800ºC). X-ray diffraction data reveal that the elevated deposition temperatures (600ºC-800ºC) result in a significant increase in hcp metallic cobalt phase and strong deformation of the hexagonal wurtzite structure of ZnO phase in the films. From crystallographic analysis, the deposition temperature shows a strong bearing on ZnO and cobalt crystallite size as well. X-ray photoelectron spectroscopy (XPS) findings point to increasing metallic Co content in the films at high deposition temperature. The potential of the films as nano-catalysts has been evaluated via Fischer-Tropsch synthesis (FTS) in a 3-phase continuously-stirred tank slurry reactor (3-φ-CSTSR) using a Robinson-Mahoney stationary basket (RMSB), and the preliminary results are discussed in terms of catalytic activity and selectivity. FT liquid fuel fractions rich in diesel and waxes have been observed.

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PA03

Syntheses and Langmuir-Blodgett Thin Films of the Partly and Fully-Substituted Ferrocenyl Pendant-Armed Spirocyclotriphosphazenes

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[keywords] Thin films, spiroferrocenylphosphazenes, crystal structure

The ultrathin films of inorganic and organic materials were obtained with different methods such as thermal evaporation, adsorption from solution, electrodeposition, sputtering, self-assembly, molecular beam epitaxy and Langmuir-Blodgett (LB) techniques [1]. The chemistry of hexachlorocyclotriphosphazenes, $N_3P_3Cl_6$ (trimer), has been widely studied since 1960 [2]. In the meantime, trimer is used as scaffolds for the construction of numerous substituted cyclotriphosphazenes. Phosphazene derivatives have found the applications in technological and medicinal areas in recent years, e.g. membranes [3], synthetic bones [4], ion-transferring agents for rechargeable lithium batteries [5] and photophysic [6]. This study deals with the condensation reactions of the tetrachloro monoferrocenyl pendant-armed N/N spirophosphazenes with piperidine. The preparations of ultrathin and highly ordered Langmuir–Blodgett films of the two phosphazenes were achieved. The structural characterizations of the LB films were made using p-polarized grazing angle (GAIR) and horizontal attenuated total reflectance (HATR) techniques. In addition, the molecular and crystal structures of three compounds were also established by X-ray crystallography. A survey of the literature indicated that there were two papers on the LB thin films of the cyclotriphosphazene derivatives, which are published by our group.

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PA04

Thin Films Electrical Conductivity Determination Using Ellipsometry

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[keywords] Polysilicon, thin films, correlation, electrical conductivity, ellipsometry.

The polycrystalline silicon layers deposited from thermal decomposition of silane (SiH_4) by Low Pressure Chemical Vapor Deposition (LPCVD) technique at temperature 620°C, either undoped or diffusion phosphorus doped ($5.38x10^{19}$ to $1.8x10^{20}$ cm^{-3}), have been studied from optically and electrically point of view. The structures are composed of p-type <100>-oriented monosilicon substrate, silicon oxide layer (100 nm) and polysilicon film (175 nm). Polysilicon layers were characterized by spectroscopic ellipsometry (SE) to determine the optical properties namely the Ψ ellipsometric angle evolution, in addition to the thickness (d). This paper presents interesting correlations between electrical conductivity and optical properties with different doping levels of polysilicon thin films. We demonstrate that there is a straightforward relationship between these properties allowing us to deduce electrical characteristics with a non-contact method.

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PA05

The effect of Cu:ZnO and Mg:ZnO thin films deposit on porous ceramic for the structural, morphological and photocatalytic properties

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[keywords] Ceramic substrate; Zirconia; Dip-goating; ZnO:Cu; ZnO:Mg; Degradation rate

Aiming at purifying water at low cost for our daily life, thin layers of zinc oxide and Cu/Mg doped ZnO are deposited on ceramic pellets based on mullite and zircon. These substrates are made with local raw material to which zirconia is added so as to create open porosity [1]. The thin films are prepared by sol-gel method. The effect of copper and magnesium doping on their structural, morphological and photocatalytic properties has been studied by different analytical techniques such as X-ray diffraction, atomic force microscopy, scanning electron microscopy, energy-dispersive X-ray spectrometry and UV-visible spectrophotometry. The photocatalytic activity has been carried out on an aqueous solution of Orange II insolated with a UV lamp [2-5]. The final results show that the porous substrates obtained with addition of zirconia and coated with active layers of Mg doped ZnO give an important photocatalytic activity more than Cu doped ZnO. This important effect can be related to the high rate of open porosity in the substrates caused by the consumption of the vitreous phase by zirconia. The open pores allow having a wider surface covered with the active film. The obtained maximum degradation rate of Orange II is 77.76% for an exposition time of 6 hours with ZnO:Cu and 80% with ZnO:Mg thin film for deposited on porous substrates.

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PA06

SiN/SiO_2 Passivation Stack Of *N*-Type Silicon Surface: Comparison Between RTO and NAOS

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[keywords] Silicon, passivation, oxidation, nitric acid.

The SiN /SiO_2 stack is widely used to passivate the surface of n-type monocrystalline silicon solar cells. In this work we have undertaken a study comparing this stack layer carried out with SiO_2 grown by both rapid thermal and chemical ways to passivate n-type monocrystalline silicon surface. The comparison concerned the passivation quality and the thermal budget.

Rapid thermal oxidation (RTO) was performed by means of single wafer furnace. The lowest temperature required to reach 10 nm oxide thickness is 950°C under the maximum allowed oxygen flow rate of 20 slm and a plateau time of 240 sec. We also found that the emissivity (technical furnace parameter) is an important parameter in the oxide growth rate.

Thermal silicon oxide of 10 nm growth in conventional furnace requires more than 60 minutes process duration at temperatures between 900°C and 950°C. This technique is considered as a very high thermal budget process.

Nitric acid oxidation of silicon (NAOS) growth rate at ambient temperature was found constant at 2.8 ±0.5 nm when immersion time varied between 10 minutes and 60 minutes. At 119°C, the oxide thickness increased from 3.7 nm to 5.5 nm with immersion time increase from 25 minutes to 90 minutes.

Three silicon nitride refractive indices were used to perform the SiN/SiO_2 passivation stack, 1.9, 2.0 and 2.1. Regarding this parameter, the minority carrier lifetime measured by means of QSSPC on symmetrical SiO_2/SiN stack structure revealed that the refractive of 1.9 performed the best passivation quality of silicon wafer surface. We also found that nitric acid oxidation performed the best passivation compared to RTO. The minority carrier lifetime has more than doubled when a refractive index of 1.9 is used.

Based on these results, the SiO_2/SiN stack using chemical nitric acid oxidation is by far the most advantageous way to passivate silicon surface. In addition to produce the most efficient passivation, this technique has the lowest thermal budget.

PA07

Hydrophilic modification of surfaces via plasma polymerization

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[keywords] plasma polymerization, hydrophilization, atmospheric pressure plasma, polypropylene

Highly hydrophilic surfaces prepared by means of plasma polymerization could be a good alternative to classical plasma activation in simple atomic or molecular gasses. Direct plasma treatment in simple atomic or molecular gasses (i.e. oxygen, nitrogen, argon, air, etc.) introduces to the surface new hydrophilic functional groups [1 - 3] and/or modifies the surface topography by plasma etching [4, 5]. The disadvantage of such a direct approach is apart from the so-called aging effect, the strong dependence of achievable wettability on the type and characteristics of treated material and discharge plasma operation conditions. Plasma polymerization enables the fast, simple and time stable hydrophilic modification of surfaces without dependence on the type and characteristics of treated material. In this work, the polypropylene surface was coated by thin layer of plasma polymer deposited from the low concentration mixture of propane-butane in nitrogen in atmospheric pressure plasma. This nontoxic and inexpensive mixture is already known to promote adhesion strength of polyester cords to rubber matrix [6]. Presented method has therefore a good potential to become a wider platform for creating cost-effective intermediate adhesive layers. Well hydrophilic thin surfaces were obtained for treatment time of 1 second and superhydrophilic surfaces were obtained after 10 seconds of plasma treatment. Thus prepared thin layers of plasma polymer have great time stability of wettability properties, are smooth, homogenous, moderately flexible and have good adhesion to the substrate. Wettability of deposited layer was characterized using water contact angle (WCA) measurement and surface free energy (SFE) evaluation. The chemical composition of deposited layer was characterized by X-ray photoelectron spectroscopy (XPS) and Attenuated total reflection Fourier transform infrared spectroscopy (FTIR-ATR). Surface morphology was observed via scanning electron microscopy (SEM).

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PA08

Synthesis, characterization and application of electrochemical corrosion of phosphonate (ETPA)

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[Keywords] Synthesis, Characterization**,** Phosphonate, Corrosion rate, Inhibition, Carbon steel, electrochemical methods

A new phosphonic acid derivative namely {ethylene bis [(2-hydroxy-5,1,3-phenylene) bis methylene]} tetraphosphonic acid (ETPA) was synthesized and characterized by ^{1}H NMR, ^{13}C NMR; ^{31}P NMR and MS spectroscopic methods. Its inhibitive action on the corrosion of carbon steel in 3%NaCl solution at 298 K has been studied. Weight loss measurements, potentiodynamic polarisation and impedance spectroscopy (EIS) methods have been used. The inhibition efficiency increases with the concentration of ETPA to attain 95% at 10^{-3}M. We have noted a good agreement between gravimetric and electrochemical methods (potentiodynamic and impedance spectroscopy (EIS)). Polarisation curves showed their behaviors as mixed-type inhibitor. EIS spectra exhibit one capacitive loop and confirm the inhibitive ability surface analysis was carried out to establish the mechanism of corrosion inhibition of carbon steel in 3%NaCl solution.

PA09

Microstructural, mechanical and tribological properties of TiAlN-(Ag,Cu) nanocomposite coatings deposited by DC magnetron sputtering for medical applications

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[keywords] self lubrication, nanocomposite coatings, tribology, wear resistance, magnetron sputtering.

AISI 420 stainless steel is currently used in the manufacture of surgical and dental instrumentation due to its hardenability, acceptable biocompatibility and resistance to corrosion. However, its resistance to wear is relatively low, and therefore multiple strategies of surface modification are offered such as plasma nitriding and hard coatings deposited by the physical vapor deposition techniques PVD, among others to reduce the wear rate and to confer this steel other variety of specific properties. In this work TiAlN coatings doped with three different contents of Ag and Cu nanoparticles were deposited onto 420 steel by means of DC magnetron sputtering using two composited targets of Ti/Al and Ag/Cu (both 50/50 %at), which were facing each other at 180 degrees. The microstructure, chemical and phase composition were analyzed by scanning electron microscopy (SEM) and energy dispersive X-ray spectroscopy (EDX), while the grain size and roughness were determined using atomic force microscopy (AFM), respectively. The hardness, Young modulus and the adhesion strength were evaluated by nanoindentation measurements and scratch test, and the tribological properties determined at temperature between 250 y 650°C using the ball on disc test method. The composite coatings showed a continuous decrease in hardness and Young's modulus, as well as a significant reduction in the coefficient of friction and in the wear rate, both with the increase in Ag/Cu content and with the temperature used in the tribological test due, on the one hand, to the low hardness of the nanoparticles in the ceramic matrix, and on the other, to the effect of solid lubrication of the same. The development of this nanostructured coating system might be considered for potential application in cutting and forming tools, but too in surgical and dental instrumentation due to its appropriate balance between hardness and wear resistance and to its possible high corrosion resistance and probable bactericidal effect.

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PA10

Micro-supercapacitors from carbon films prepared onto nanowires silicone substrate

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[keywords] Supercapacitors, silicon nanowires, carbon nanomaterials.

In this work, diamond-like carbon (DLC) thin films were electrodeposited onto nanowires silicon (NWSi) from organic solution of dimethylsulfoxide (DMSO). The morphological and electrochemical properties as well as the chemical composition of films was investigated. Raman spectroscopy, scanning electron microscopy (SEM) and X-ray diffraction (XRD) were used to characterize the elaborated films. The electrochemical performance of DLC@NWSi shows ideal rectangular voltammograms indicating the typical capacitive behaviors with good charge propagation and easy ion transport in the electrode materials. The capacitance as measured via the electrochemical performance reaches 200 μF/cm^2 and an energy density of 16μJ/cm^2.These results confirm that DLC films coated SiNW is a promising electrode for micro-supercapacitors.

PA11

Microstructure and electrochemical behaviour of alumina ceramic films developed on stainless steels used in the nuclear industry by electrolytic plasma processing

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The candidate materials for the Generation-IV nuclear power reactors include modified stainless steels, as 316L in order to improve corrosion resistance in extreme conditions (liquid metals, higher temperature than the upper limit of conventional austenitic stainless steels).
The objective of the study was to correlate microstructure with electrochemical behavior of alumina coatings developed on 316L stainless stee by various electrolytic plasma processing :

-cathodic polarization in 0.5 MAlCl3 in Deep Eutectic Solvent ChCl-ureea 1:2 molar ratio;
- micro-arc oxidation in aqueous solution of 0.1 M NaAlO2 and 0.05 M NaOH.

The obtained films were characterized by Electrochemical Impedance Spectroscopy, SEM and XPS. Corrosion resistance of the oxide coatings was assessed by potentiodynamic polarization measurements.
Potentiodynamic polarization measurements show that plasma electrolysis techniques can produce thin films based on aluminum on 316L austenitic stainless steel which significantly improve electrochemical behavior.
Some considerations for the further development of the new advanced nuclear materials are presented.

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PA12

Analysis by ellipsometry of porous silicon and AC impedance spectroscopic investigation of a-Si:H deposited on multilayered porous silicon

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[keywords] a-Si:H/c-Si heterojunction, impedance spectroscopy, porous silicon, negative capacitance.

In this communication, we study structures comprised thin hydrogenated amorphous silicon (a-Si:H) films deposited on multilayers of porous silicon (distributed Bragg reflector DBR) formed from crystalline silicon (c-Si) wafers. These structures was analysed by Impedance spectroscopy (IS).It is shown that the Bragg mirrors formed on crystalline silicon play an important role in the light trapping in a-Si:H [1]. The a-Si:H thin films were deposited by the DC magnetron sputtering technique in a mixture of argon and hydrogen atmosphere. The structural features of porous silicon, in terms of porosity, thickness and surface roughness, were determined using spectroscopic ellipsometry [2]. The data obtained from IS were used in order to identify electronic behaviour using equivalent AC circuit which was obtained by fitting the measured impedance data. Data of IS measurements define an electrical equivalent circuit model able to explain the role of the different structure components, including the interfaces [3]. For this purpose, we have proceeded to characterize successively porous silicon monolayers, then structures porous silicon multilayers as DBR and finally structures of a-Si:H/c-Si and a-Si:H/PSi(DBR)/c-Si. A negative capacitance was found for the heterojunction with DBR which was attributed to the existence of defect states at the interfaces between porous and amorphous semiconductor [4].

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PA13

Development of NiO_x and WO_3 Nanofilm Layers and Polymer Electrolyte for Electrochromic Devices

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[keywords] Electrochromic device, thin film, gel electrolyte, coloration efficiency, optical properties.

Electrochromism is the property of certain materials which involves a change from a bleaching state to a colored state as effect either by the action of an electrical voltage or current. Electrochromic devices (ECD) are formed by this kind of electrochromic materials that are capable of continuously and reversibly modulating their color, usually from a bleaching state to a colored one, with the application of a small electric current (~1 V). The electric current induces in them a reaction of reduction (gain of electrons) or oxidation (loss of electrons) that modifies the range of energies in which the compound interacts with visible light. For this reason, such materials are called electrochromic and have a wide range of applications in technology, mainly for intelligent windows [1]. In this work, a multilayer electrochromic device is being developed by DC magnetron sputtering, where indium tin oxide (ITO) thin film layers, due to both high electrical conductivity and high transparency in the visible spectrum (~85%) will be used as electrodes [2]. Since tungsten oxide (WO_3) layers serve as cathodic coloring under charge insertion and nickel oxide (NiO_x) layers serve as anodic coloring under charge extraction, they are complementary with each other in the ECD, following the order ITO/WO_3/Polymer-Electrolyte/NiO_x/ITO/Glass [3]. Then by applying the potential on the ITO layers in the ECD, a transition from a transparent state to the colored state will be reached. In addition, due to a good performance and high transparency, a poly (methyl methacrylate) (PMMA) based electrolyte will serve as gel electrolyte [4]. Then, the characteristics of the EDC as coloring/bleaching process, response time, charge density and the optical transmission spectra in the visible region will be determined.

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PA14

Three-layer model in optical characterization of randomly rough silicon surfaces covered with native oxide layers

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[keywords] Silicon, native oxide layer, roughness, ellipsometry, reflectometry

Silicon single crystal (Si) surfaces covered with very thin native oxide layers (NOL) have been studied using optical techniques frequently. In particular spectroscopic ellipsometry and spectroscopic reflectometry have been employed for the optical characterization of this system. This is caused by its structural simplicity, extensive practical utilization and perfect knowledge of the optical constants of silicon single crystal. The optical characterization of the system Si/NOL is significantly more complicated if random roughness occurs in its boundaries. So far an insufficient attention has been devoted to the optical characterization of the system Si/NOL with randomly rough boundaries.

In this contribution the new approach usable for the optical characterization of samples of the system Si/NOL exhibiting different random roughness will be presented. Some samples exhibited the the rms values of heights of irregularities in nanometers (nanometric roughness) while other samples exhibited this parameter in values larger than 10 nm (rougher samples). Random roughness of the boundaries of the samples characterized was generated by anodic oxidation of the smooth Si samples and subsequent dissolution of the originated oxide films. Experimental data of the samples were obtained using variable angle spectroscopic ellipsometry and spectroscopic reflectometry. The associated ellipsometric parameters and reflectance were measured within the near IR, visible and UV ranges. The ellipsometric and reflectometric data of each rough sample were processed together with the data corresponding to a smooth sample of this system, i.e. multi-sample method was utilized in order to remove or reduce a correlation among parameters sought by means of the least-squares method.

In our structural model of the system considered the NOL was represented by the identical thin film (ITF) (the boundaries of the ITF are identical from both the geometrical and statistical points of view). In the upper and lower boundary of the ITF the existence of very thin effective layers (EL) with the same thicknesses representing fine sub-nanometric roughness was assumed. Formulae of the effective medium approximation (EMA) were used to express their refractive indices. Thus, the three-layer system was taken into account onto rough Si surfaces in the optical characterization. The Rayleigh-Rice theory (RRT) was utilized for processing experimental data of the samples exhibiting nanometric roughness. As for the rougher samples of the Si/NOL system, the combination of scalar diffraction theory (SDT) and RRT had to be used. The use of the RRT for describing multilayer systems containing the ITF represents a unique approach.

For selected samples it is shown that one can determine the values of the NOL thickness, EL thickness and roughness parameters, i.e. the rms values of the heights and values of the autocorrelation length, describing nanometric roughness and larger roughness of the samples studied. The EL thickness values enable us to estimate the rms values of sub-nanometric roughness. The values of the roughness parameters are compared with those determined by atomic force microscopy and by utilization of simpler structural models (e.g. without the EL).

PA15

Optical characterization of non-stoichiometric silicon nitride films exhibiting combination of several defects

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[keywords] Silicon nitride, ellipsometry, optical characterization.

The silicon nitride films have important applications in practice, for example, they are used in antireflection coatings on silicon solar cells. They are also used in reflectors on back sides of these cells. By regulating the stoichiometric ratio it is possible to create inhomogeneous films that could replace layered systems realizing antireflection coatings or spectral filters. Therefore, it is necessary to know the optical properties of these films and how they are influenced by technological conditions of their preparation.

The films were deposited onto double-side polished silicon single crystal wafers by reactive magnetron sputtering. The stoichiometric ratio was changed by regulating the nitrogen flow rate. Results concerning films with different stoichiometric ratio are presented. The optical characterization was performed using spectroscopic reflectometry and variable-angle spectroscopic ellipsometry in near IR, visible and UV ranges.

The dielectric response of the non-stoichiometric silicon nitride is modeled using the universal dispersion model (UDM). This dispersion model is based on the parametrization of the joint density of states and it is able to express the dielectric response of a wide class of solid materials in a wide spectral range [2]. In this model, the imaginary part of the dielectric function is expressed as a sum of functions modeling various absorption structures derived on the basis of theoretical and empirical knowledge. The real part of the dielectric function is then calculated from the imaginary part using the Kramers‑Kronig relation. The dielectric model of non-stoichiometric silicon nitride includes contributions representing direct electronic excitations, (exponential) Urbach tail (weak absorption below the bandgap) and excitonic effects. The prepared films exhibit these defects: inhomogeneity (refractive index profile), uniaxial anisotropy and random roughness of the upper boundary. The inhomogeneity is probably connected with deposition conditions. The uniaxial anisotropy is probably caused by internal stress or by columnar structure of the films. The optical quantities of the films combining the refractive index profile and uniaxial anisotropy are calculated by the Yeh matrix formalism applied to sufficient number of homogeneous uniaxial layers approximating these inhomogeneous films. AFM studies revealed slight random roughness of the upper boundaries of the films, which could be taken into account by either the Rayliegh−Rice theory (RRT) or by the scalar diffraction theory (SDT). In the infrared region, where the substrates become transparent, the reflections on back sides of these substrates must be taken into account. This effect is included into the calculations using the incoherent formalism working with the Mueller matrices.

Both the reflectometric and ellipsometric experimental data are processed simultaneously by the least squares method (LSM). Since the inclusion of all the defects requires model with many parameters, the experimental data for several samples with films deposited under the same technological conditions but differing in deposition times (i.e. thicknesses of the films) are processed simultaneously. In other words, the multi-sample method is used. This method reduces the correlations between the parameters sought within the LSM.

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PA16

Electrodeposition and characterization of Ni-Cr composite coatings

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[Keywords] Ni-Cr composite coatings; electrodeposition; electrochemical impedance spectroscopy (EIS).

In this study, Ni-Cr composite coatings were electrodeposited from citrate bath onto Cu substrates at different values of current densities. The effect of plating current density on morphological and structural characterization of Ni-Cr electrodeposited composite coatings were investigated by means of scanning electron microscopy (SEM) and X-ray diffraction (XRD), respectively. Potentiodynamic polarization and electrochemical impedance spectroscopy (EIS) tests in 3.5wt % NaCl solution were used to evaluate corrosion résistance of Ni-Cr coatings. The results showed that the Ni-Cr alloy coatings can deposited in a certain range of current densities (1-8 A/dm²). SEM images showed that the surface morphology of all coatings contained microcraks and pores. XRD patterns indicate the formation of Ni-Cr and Cr_3Ni_2 phases. The alloy coating deposited at 3 A/dm², had the best corrosion resistance among all the samples.

PA17

Preparation of iridium films using a new precursor [Ir(cod)Cp*] by MOCVD method

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[keywords] iridium coating, chemistry of precursors, vapor pressure of iridium compounds.

The method of chemical deposition from the gas phase (CVD) makes it easy to obtain coatings from refractory metals (or their oxides) such as iridium. The properties of precursors have a determining effect on the characteristics of the coatings obtained, therefore studying their chemical and physical properties is an important task. Low deposition temperature, high vapor pressure, possibility to obtain metal iridium coatings using either hydrogen or oxygen as the reagent gas, and various aggregate states of complexes under standard conditions, made the cyclopentadienyl complexes of iridium (I) one of the most promising class of precursors for MOCVD. Unfortunately, this class of compounds has been little studied in CVD. Only two compounds of this class Ir(cod)Cp^x (x =Et, Me) are sufficiently well studied in chemical precipitation [1-3].

In this paper, the new iridium precursor ([Ir(cod)Cp*], where cod – 1,5-cyclooctadiene, Cp* - pentamethylcyclopentadienyl) has been studied for the first time. The products of the thermal decomposition of this compound in the presence of oxygen and the thermal stability in a vacuum were analyzed by mass spectrometry. Thermal decomposition data showed that in the presence of oxygen the compound decomposes into carbon oxides and water, which should positively influence the purity of the coatings. In addition, under vacuum conditions, this complex is stable even at 500 ^oC.

Based on the data obtained, it was concluded that this complex is a promising precursor for CVD. In an oxygen atmosphere, pure iridium coatings were obtained on Si (100) and analyzed by XRD, EDX and SEM methods. In addition, the influence of the experiment parameters (concentration of the precursor vapors, deposition temperature, deposition time) on the structure and morphology of the obtained films were investigated.

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PA18

Structural, morphological and photocatalytic properties of Fe doped TiO2 thin layers

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[keywords] TiO_2 nanoparticules; Fe doped TiO_2; thin films; sol-gel.

In this study, undoped and Fe doped TiO_2 thin films has been prepared via sol-gel method using the tetraethyl-orthotitanate as source of Ti and Fe(III) nitrate as source of Fe^{3+} doping. Scanning electron microscopy (SEM-EDX), X-ray diffraction (XRD), and UV–vis spectrum were employed to examine the effects of Fe element on morphology, structure, optical characteristics and photocatalytics behavior of TiO_2 films. XRD patterns showed the presence of TiO_2 anatase phases only, no other phase has been appeared. SEM image confirm the nanometric grain size of all samples and a low decrease in band gap were we increases the Fe doping percentage. It is also observed that no enhancement in photocatalytics activities of Fe doped TiO_2 thin films.

PA19

Growth Lithium Tetraborate Li2B4O7 by Czochralski Method Study of Non-Linear Properties by Fourth Harmonic Generation

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[Keywords] $Li_2B_4O_7$, LTB, nonlinear optics, ONL, Harmonic

The $Li_2B_4O_7$ (LTB) crystal was grown in induction heating furnace by the Czochralski, Cz method using a platinum crucible [1]. LTB is a congruent fusion; its melting temperature is 917 °C. Polycrystalline LTB was prepared by a conventional solid-state reaction and successfully crystal grown is obtained. To investigate their behavior during pulling, crystal LTB obtained is thoroughly characterized by Raman Spectroscopy. We performed the shaping of the samples by a polishing technique respecting the hygroscopic of the borate crystals and by the use of original orientation techniques of LTB samples by Raman Spectroscopy and Coroscopy. A sample of 2 mm thickness was selected for optical absorption studies [2] and optical non -linear proprieties, ONL [3]. Fourth harmonic generation at 266 nm was performed in our crystal LTB and 12 % conversion efficiency from 532 to 266 nm has obtained.

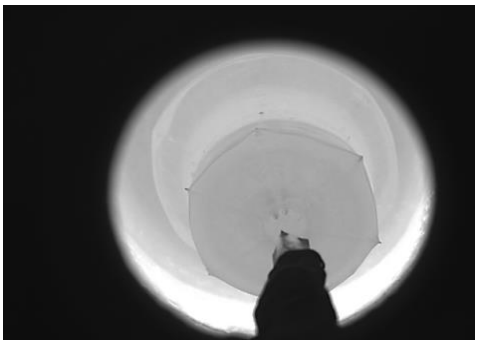

Fig1.Cz Growth Cristal LTB

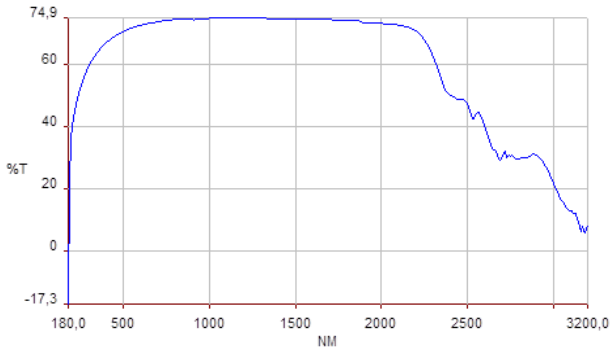

Fig2. Optical Spectral Transmiter

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PA20

Improved absorbance the mixed V_2O_5 / F_2O_3 / SiP structure

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Mixed oxides such as SiO_2-TiO_2 were used by K. Chhor and all in the photocatalytic degradation of phenol and salicylic acid as a function of the calcination temperature [1]. The materials were prepared by sol-gel route. The amount of hydroxyl which is present on the surface of the materials strongly modifies the adsorption of molecular oxygen (O_2) and thus modifies the photocatalytic activity.

On the other hand, K.Y. Jung and S.B. Park prepared mixed oxides (SiO_2-TiO_2 and ZrO_2-TiO_2) by sol-gel [2]. They studied the photocatalytic decomposition of trichlorethylene as a function of the silicon content

Our work consists in improving the absorbance in the whole solar spectrum (UV and red infrared) of the structure, for which we have produced a V_2O_5 / F_2O_3 mixed layer on porous silicon substrates with a resistivity between 0.01 and 0.1 Ω cm. The latter was prepared by electrochemical voice in an HF / ethanol bath.

A first layer of vanadium oxide was deposited on three samples: the first one without heating, the second heating of the solution at 100 ° C. and the third heating at 150 ° C. These deposits were followed by second layer deposition of iron oxide by the sol-gel technique at temperatures of 50 ° C. and 70 ° C. of the solution (F_2 O_3)

The structure produced was analyzed by UV, FTIR, DRX spectrophotometer

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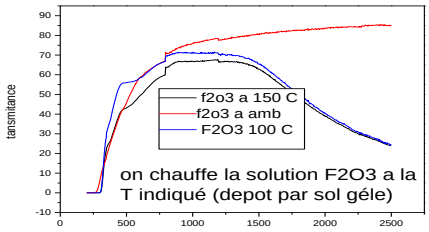

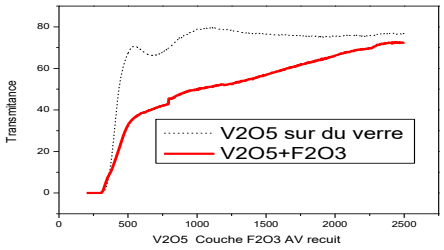

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PA21

YIG Film Grown on Quartz by Spin-Coating

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[keywords] YIG, Spintronic, Spin-Coating, Optoelectronics.

Yttrium iron garnet (YIG) is a ferrimagnetic material that is widely used in magnetism for its great applications in spintronic and optoelectronic devices. Due to low-dimension applications, YIG is generally prepared in thin-film form rather than bulk [1-3]. Thus, growing of YIG films become crucial important since they are generally grown on gadolinium gallium garnet (GGG) substrate by using vacuum system. Because both GGG substrate and production method are expensive, their usage in technology is limited. Nowadays, new economical production methods and searching different substrates to obtain low damping constant in YIG film become important researching area. Here, we have worked on the synthezing of YIG material and growing it on to the quartz substrate by spin-coating method. Since quartz substrate and production system are much cheaper than GGG and vacuum system, respectively, the results are important to use spintronic applications, such as spin-wave propagation. After the film grown on quartz substrate we applied a heat treatment to obtain crystal YIG. In the XRD experiment, we found that the YIG film has cubic crystal structure and mainly grown in (420) crystal direction. The cross-section SEM images show that the YIG film is around 350 nm thickness and its thickness is almost same through the film. The magnetic measurements show that magnetic anisotropy is in-plane easy axis with a very low coercive field. The results indicate that YIG film can be successfully grown on quartz substrate by a cheap spin-coating system. In the presentation, we will further discuss the other physical properties of YIG films.

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PA22

Sol-gel Processed Niobium-doped Titanium Dioxide as Alternative to Indium Tin Oxide in Transparent Conductive Coatings

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Indium tin oxide (ITO), which contains up to 90% of indium, shows excellent electrical conductivity and a high level of light transmission, thus being used in the majority of transparent conducting coatings (TCCs) produced. Unfortunately, indium is an expensive material with limited supply due to its increasing scarcity, so finding an economically viable and more commonly available alternative is becoming an important priority. One area of particular interest lies in materials based on titanium dioxide, especially the anatase polymorph. TiO_2 in its anatase phase has a large band gap of 3.2 eV and is highly optical transparent as well as conductive when suitably doped with a second metal. In this work niobium-doped TiO_2 could be identified as a more economical alternative to ITO. Sputter coating and other conventional methods have proven to be limited in terms of both cost and process efficiency. For that reason, the sol-gel method, which is simple, flexible and can be employed in ambient air and temperature, was selected as one that is more desirable for industrial production [1].
In this work, optical and electrical properties of non-doped and Nb-doped titanium dioxide thin films processed by the sol-gel spin-coating method were studied. The films were sintered at 500 °C and then the crystallisation sequence studied via XRD. Film formation and thickness were determined by SEM and spectroscopic ellipsometry respectively. The influence of processing conditions on the film morphology was investigated using AFM. Transparency of the coatings was measured by UV/VIS spectroscopy, and Tauc plots were used to calculate the band gap. The conductivity of the thin films was measured using a Keithley 4200-SCS.

This work has been carried out as part of the INFINITY project which has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 641927.

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PA23

Ab initio study of thermal properties of Zr-Fe system

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[keywords] Zr-Fe system, ab initio, QHA, thermal expansion, Grünesien parameter

Zirconium alloys have been widely used as the fuel-rod cladding material in the core of nuclear power reactors. However, they suffer some important weaknesses during nuclear power plant operation. To reduce the influence of the severe conditions in a nuclear reactor environment and then to increase ageing of the cladding and enhance the safety of the NPP worldwide, some alloys are required to achieve good mechanical and thermal properties. These alloys are all alloying with a certain amount of Fe. Zr-Fe system has received much attention in the past decades, it has been examined the existing phase diagrams of Zr-Fe [1-2]. It was investigated also by Aubertin *et al* [3] that Zr_2Fe was determined to be a high-temperature phase. Besides, Zr_4Fe was shown in Zr-Fe (Fe between 390 and 3000 wt-ppm) with a tetragonal structure [4], other researchers [5] found that the composition of 76.5% Zr and 23.5% Fe suggests that Zr_2Fe in St198 is stable at room temperature. Lumley *et al* [6] has confirmed that Fe atoms occupy octahedral interstitial (O) sites and proven also that the formation energy for intermetallic phase of Zr_2Fe is metastable. On the other hand, few recent atomistic studies investigate the impact of iron on Zirconium. However, it has not yet been established whether the existence of Iron in octahedral position can improve and/or achieve good results in thermal properties on the cladding material. Since there are a little first principles data available in the literature for the Zr-Fe that can be used to predict the accuracy of the DFT model, the main purpose of this work is to explore and examine the effect of iron on thermal properties of Zr-Fe system such as thermal expansion coefficient, bulk modulus, thermal Grünesien parameter, heat capacity, and volume expansion using DFT modelling within the Quasi-Harmonic Approximation (QHA). It is of interest to investigate what causes such behavior and its impact in making lifetime of the fuel-rods.

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PA24

Effect of deposition temperature and crystalline system of substrate on the characteristics of Titanium Nitride layer deposited by active Radio-Frequency (RF) magnetron sputtering

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[keywords] TiN, stainless steel 316, MgO, Substrate temperature, crystalline system.

The substrate temperature presents an essential parameters that influence the characterization of metallic thin films, in this study a layer of Titanium Nitride TiN was deposited by active Radio-Frequency (RF) magnetron sputtering [1,2], on two substrates of different crystalline system, a monocrystalline substrate "magnesium oxide MgO" and another polycrystalline substrate stainless steel 316, three deposition temperatures were used (Ts = 25°C, 500°C, 700°C), the X-ray diffractions of TiN deposited on MgO at 700 ° C, shows the presence of two peaks (002) and (004), also four peaks separated by 90 ° in the PHISCAN, this peaks show the epitaxial orientation of the TiN layer, however the TiN layer deposited on the stainless steel 316 has a polycrystalline structure, two peaks appeared (111), (002) with a relatively better crystallinity at a temperature of 25 °C. Morphologically the TiN grains get bigger with the substrate heating, concerning the chemical composition which has been carried out on an EDS, the Ti / N ratios shows the inverse effect of the substrate temperature on the stoichiometry of the two TiN films deposited on the two substrates, a ratio of 0.94% is noted for the TiN layer deposited on MgO at a temperature of 700 ° C., however the TiN layer deposited on stainless 316 has a ratio of 0.95% at a temperature of 25 ° C.

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PA25

The Growth and Interface Analysis of Diamond on GaN

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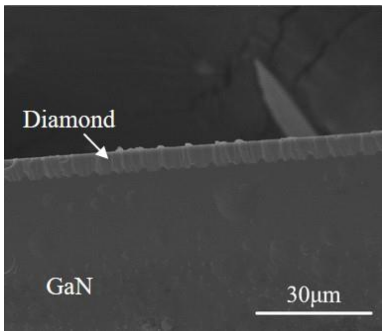
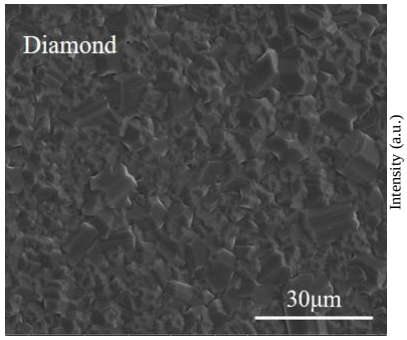
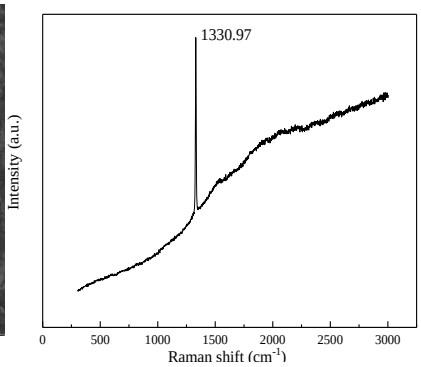
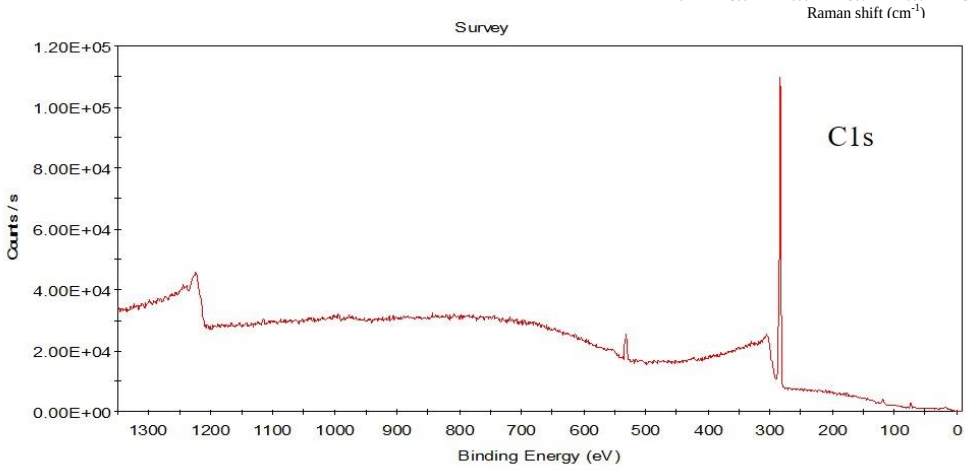
To solve the thermal management problem of GaN devices, diamond was chosen to play a role as heat sink. In this paper, polycrystalline diamond was deposited on GaN with some different interlayers. 50μm polycrystalline diamond was grown on 200nm Si3N4 and Si interlayers by microwave plasma assisted chemical vapor deposition (MPCVD). And different results were shown when different interlayers were used. The grown polycrystalline diamond was characterized by stereomicroscope, SEM, XRD and Raman spectroscopy and XPS. The GaN substrate was also characterized by XRD and Raman spectroscopy before and after depositing. The thermal resistance was measured by timedomain thermoreflectance (TDTR). A simulation was done to verify the effect of the diamond heat sink and good result ($\Delta T < 20℃$) was achieved.









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PA26

Room Temperature Deposition of Homogeneous, Highly Transparent and Conductive In_2O_3 Films by Reactive High Power Impulse Magnetron Sputtering

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[Keywords] In_2O_3 films, carrier concentration, mobility, HiPIMS

In_2O_3 films have been deposited by reactive high power impulse magnetron sputtering (HiPIMS) from a metal target and a ceramic target without thermal assistance. These films have been compared in terms of their optical, electrical and structural properties. While both metal and ceramic targets deposited films show comparable transmittance, their electrical properties are significantly improved by using the metal target. The HiPIMS deposited films, using the metal target, show a low resistivity down to the order of $10^{-4}\Omega$ cm with a good homogeneity across the substrate. The carrier concentration reached up to 10^{20} cm^{-3}, and the mobility reached up to 56 cm^2/Vs. This improvement of the film properties can be related to the reaction and growth process between metal ions or atoms and oxygen. This allows the process to take place in the transition mode and to deposit highly conductive, transparent In_2O_3 films on large surfaces at low temperature. While the overall oxygen content is under that of stoichiometric In_2O_3, higher localization of oxygen vacancy are found.

PA27

Magnetron sputtered TiN thin films toward enhanced performance supercapacitor electrodes

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[keywords] Supercapacitor, Energy storage, Titanium nitride, Thin film, Magnetron sputtering.

Energy security has become a key factor that restricts the sustainable development of human civilization, triggering tremendous efforts to develop renewable and non-polluting new energy. Among energy-storage systems, supercapacitors have been considered to have potential applications in portable electronics and hybrid electric vehicles due to fast charge/discharge rate, long-term cycle stability, excellent rate capability, high power density, and low cost [1-2]. Significantly, supercapacitors can provide higher power densities than conventional capacitors, and they also possess energy densities much higher than those of batteries [3]. Herein, binder-free titanium nitride (TiN) thin film electrodes for supercapacitors prepared by reactive magnetron sputtering technology are reported. The effect of N_2 content on the supercapacitor performance is evaluated. A highest specific capacitance of 27.3 mF cm^{-2} at a current density of 1.0 mA cm^{-2}, together with excellent cycling performance (98.2% capacitance retention after 20000 cycles at 2.0 mA cm^{-2}) is achieved in a 0.5 M H_2SO_4 aqueous electrolyte. More importantly, a symmetric supercapacitor device assembled on the basis of TiN thin films can deliver a maximum energy density of 17.6 mWh cm^{-3} at a current density of 0.2 mA cm^{-2} and a maximum power density of 10.8 W cm^{-3} at a current density of 2 mA cm^{-2} with remarkable cycling stability. As a consequence, TiN thin films demonstrate great potential as promising supercapacitor electrode materials.

* This research is financially supported by the National Nature Science Foundation of China (No. 51372212, 51601163).

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PA28

A new p-type transparent Se doped La_2O_3 semiconductor film deposited by a novel two-step rf magnetron sputtering and selenide processs

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[Keywords] Se doped La_2O_3, rf magnetron sputtering, optical properties, p-type.

Transparent conductive oxides(TCOs) are widely used in optoelectronic devices, such as solar cells, flat panel display, and touch panel [1-3]. Nowadays, the n-type TCOs are mostly used in the industry. However, in order to meet the requirements of industry, p-type TCOs are attracting the interests of researchers. Recently, a typical P-type semiconductor is $Cu^{I}M^{III}O_2$ materials with delafossite structure, such as $CuYO_2$, $CuAlO_2$, and $CuScO_2$. However, the conductivity and optical properties of these substances are not particularly good. For example, the transmittance of $CuAlO_2$ in mid-infrared region is only 75%, and its carrier concentration is only about $1.3\times10^{17}cm^{-3}$. So, to sum up, a new p-type semiconductor material has become an urgent need.

Rare-earth elements, which are abundant in China, are regarded as the source of life for functional materials. Lanthanum is one of the rare-earth elements. Its common oxide is lanthanum oxide (La_2O_3). It's based on the first principle that La_2O_3 with a large bandgap (approximately 4.3 eV) [4] has potentially excellent optical properties in visible light; and we also calculated the band gap of Se doped La_2O_3 according to first principle. The band gap of Se doped La_2O_3 is about 3.5 eV, which ensures the high transmittance of Se doped La_2O_3 film in visible light. And the effective hole mass of Se doped La_2O_3 film is less than the mass of an electron. So it could be a candidate of a new p-type semiconductor film.

A novel two-step rf magnetron sputtering and selenide processs is used for preparing Se doped La_2O_3 films on quartz and sapphire (0001) substrates in this work. The structure and composition of Se doped La_2O_3 films are studied, and the effect of the annealing temperature (400–800 ˚C) on the optical properties and electrical properties of the Se doped La_2O_3 films are investigated. Results indicate that with an annealing temperature around 700 ˚C, the optical and electrical properties of Se doped La_2O_3 films can be significantly improved. And the annealing time and doping quality of selenium were also discussed in our work.

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PA29

Optical constants and structural properties of nanostructures with low dimensions

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[keywords] ultra-thin films, nanostructures, metamaterials, nanosatellites

Low dimensions of the metamaterial structures are essential in miniaturized optical systems. Nevertheless, these ultra-thin films are not easily achieved because of difficulty in controlling the accuracy of the nanoscale film. In this study, we analyzed several nanostructures of noble metals (Ag and Au) ultra thin films, having thickness values in the range 10 – 100 Å and deposited onto glass substrates by radio frequency magnetron sputtering (rfMS) technique. A comparative analysis was conducted in measuring the thickness of the corresponding Ag and Au ultra thin films, using low coherence light interferometry and stylus profilometry methods. The effect of deposition conditions on the structural properties of these ultra thin films were discussed based on XRD and XPS results. AFM technique was used to investigate the surface morphology of the obtained films. Transmittance spectra (in double-beam configuration) were recorded in the 190 nm – 3000 nm wavelength range and, from these, optical constants were obtained for the Ag and Au thin films. Optical properties of these oxide films, in the near infrared (NIR) spectral range, were described by the Drude free electron model. The electrical conductivity was measured using the four-points method. These ultra thin layers/ nanostructures with metamaterial-like properties and small dimensions present interest for advanced technologies to be integrated in the micro and nanosatellites.

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PA30

A comparative study of physical properties of ZnO thin films deposited by chemical spray using different amounts of ethanol and methanol in the starting solution

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Coating technologies have drawn attention mainly due their functional advantages over bulk materials: their versatility and the low cost operations. Among these technologies, the spray pyrolysis is a cheap an effective method based on a variation of the chemical vapor deposition (CVD). process In this method, the precursor of the material to be deposited is sprayed with a nozzle over a heated substrate, assisted by a carrier gas. The droplets arrive to the substrate and the solid compounds react to become a new chemical compound. Transparent conductive and polycrystalline zinc oxide (ZnO) thin films were deposited on soda lime glass substrates using the pneumatic chemical spray technique with different amounts (30, 50 and 70 ml) of ethanol and methanol respectively in the starting solution.

During the synthesis, the surfaces of the substrates were kept at 400, 450 and 500 ^{o}C for each one of ethanol and methanol concentrations. The effects of the mentioned parameters on compositional, structural, morphological, electrical and optical properties were studied with Rutherford Backscattering Spectromety (RBS), X-ray diffraction (XRD), Scanning Electron Microscopy (SEM), the Four Point methods and Ultraviolet and Visible Spectroscopy (UVS). The results show that the atomic Zn concentration in the films increases with the volumen of sprayed solution and with the substrate temperature (T_s). On the other hand, the Band gap energy seems not to be sensitive to ethanol and methanol concentration; meanwhile higher E_g values were observed in the samples deposited at T_s= 450 and 500 ^{o}C. The resistivity shows noticeable variations with the amounts of ethanol and methanol respectively, in the sprayed solution. In films produced with ethanol, for instance, the electrical resistivity shows a remarkable decrease: 2.91×10^{-2} Ω cm (70 ml ethanol), 2.15×10^{-2} Ω cm (50 ml ethanol) and 1.57×10^{-2} Ω cm (30 ml ethanol) when the films were prepared with substrate kept at 450 ^{o}C.

PA31

Toward Controlling the Composition and Properties of SiO_x Films by Atomic Layer Deposition

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[keywords] Superlattices, SiO_x Films, Atomic Layer Deposition.

SiO_x based superlattices play an important role in the research and application of optoelectronic and semiconductor [1, 2], the advantage of atomic layer deposition (ALD) on precise control of thickness and chemical stoichiometry of thin films allows the preparation of size- and distribution-controlled silicon nanocrystals [3]. In this study, silicon dioxide (SiO_x) thin films with different chemical stoichiometry were deposited by ALD with various deposition parameter, the effect of process parameter variation on the film properties was systemically studied. Structural (XRR), compositional (XPS), morphological (AFM) and optical/electrical (Spectroscopic Ellipsometry) characteristics of the films have been studied in order to obtain the best ALD deposition process. The film thickness, density, surface roughness, refractive indices and the optical bandgap of the thin films were investigated in detail. After investigation of the impact of deposition temperature and precursor pulse time on film growth rate and composition, the growth temperature widow and suitable pulse time to prepare SiO_x film with desired chemical stoichiometry were found. Meanwhile, the experiment results indicated that the surface roughness of SiO_x films decreased as the increase of the temperature from 100 to 250 ^oC, and the refractive index of these films also changed for different deposition process. For different SiO_x films, XPS survey scans indicated the presence of silicon, oxygen, and carbon elements with concentrations ranged from ~47, ~48, and 5 at. % to ~32%, ~63.8, and 4.2 at. %, respectively, which means the SiO_x film with x change from 1 to 2 can be precisely prepared by controlling the ALD process. These results means that wonderful SiO_x/SiO_2 superlattices can be obtained by optimizing ALD process and further research.

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PA32

Influences of Gadolinium Doping on Microstructure and Optical Properties of Cadmium Oxide Thin Films by Reactive High Power Impulse Magnetron Sputtering

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[Keywords] CdO films, carrier concentration, mobility, HiPIMS

The influences of gadolinium doping on the microstructure and optical properties of cadmium oxide films were studied in detail with the aid of various characterizations deposited by high power impulse magnetron sputtering (HiPIMS). X-ray photoelectronic spectroscopy analysis shows that gadolinium atom forms chemically oxidized bonds in Cd–O matrix. X-ray diffraction results demonstrate that CdO structure remains FCC structure with gadolinium doping, whereas the preferential orientation transforms from (222) into (200) orientation. Gadolinium doping prevents the large crystalline growth, and this role still works under both nitrogen and air annealing processes. Similarly, CdO films show rough surface under annealing conditions, but the force has been greatly weakened at high doping level. It is clear that refractive index and extinction coefficient are closely correlated with crystalline size for undoped films, whereas it turns to the doping level for doped films, which can be performed by the mechanism of gadolinium atom substitution. This work provides a very useful guild for design and application of optical–electronic devices.

PA33

High Mobility and Transmittance of p-Type Copper Iodide Thin Film Fabricated via Solid Iodination Method Layer by Layer at Room-Temperature

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[Keywords] copper iodide, solid iodination, high mobility, transparent p-type semiconductor

Copper iodide in the zincblende ground-state phase (γ-CuI) is a p-type transparent conductive semiconductor with unique optoelectronic properties. The wide direct bandgap (3.1 eV at room temperature) of CuI allows for a high transparency in the visible spectral range. CuI is a native p-type conductor due to copper vacancies with a high hole mobility (>40 $cm^2V^{-1}s^{-1}$ in bulk) owing to the fairly small effective mass of $0.30m_0$ for the light holes. On the other hand, CuI does not require high synthesis temperature like other p-type TCs. The stable cubic structure makes it easy to synthesize CuI thin films near room temperature using a number of chemical and physical methods. In this work, CuI thin films were grown on quartz substrates using a simple solid iodination reaction method at room-temperature layer by layer assisted by magnetron sputtering. It was found that γ-CuI films have a uniform and dense microstructure with shiny appearance. Transmission spectra indicated that CuI thin films show an average transmittance of >75% in the visible spectral range, which is higher than that prepared by one-step method. At the same time, the films exhibit high mobility value of 14 $cm^2 V^{-1} s^{-1}$, bulk concentration of 10^{19} magnitudes.

PA34

Characterization of PLA/PCL films and plasticized PLA/PCL films with plasticizers vegetable (TEC and PEG_3)

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[keywords] Poly lactic acid (PLA), Polycaprolactone (PCL), Plasticizers vegetable, Biodegradable.

Recently, biodegradable materials have caught a considerable attention due to increasingly environmental concern, and realization that petroleum resources are finite. Such polymers can be classified into four main groups: natural polymers, such as starch, protein, and cellulose; synthetic polymers from natural monomers, such as poly lactic acid (PLA); polymers from microbial fermentation, such as polyhydroxybutyrate (PHB); and petroleum-based polymers such as polycaprolactone (PCL) [1]. Poly lactic acid (PLA) has been intensively studied and widely used for such applications because of its high biocompatibility, good biodegradability, and physical properties [2-7]. However, one major disadvantage of PLA is the transition of ductile to brittle failure in tension due to physical aging [8]. In contrast, PCL is well-known synthetic, bio-degradable, semi-crystalline polyester, characterized by a high elongation at break and high flexibility but its strength is relatively low and its melting point at 60 °C is too low for various applications. Thus it is quite reasonable to expect that the blending of PLA with PCL may bring about either improved flexibility or increased strength in comparison with each individual component. In recent years, blends of PLA with more flexible biodegradable polymers, such as PCL, have been developed and investigated [9-12]. Although the blends of these two polymers could not show the desired properties due to immiscibility independent of the composition, there are some interesting and noteworthy results. Yang and al. used differential scanning calorimetry (DSC) and optical microscopy and have reported that, although the PLA/PCL system exhibited phase separation in the melt, the crystallization rate of PLA could be enhanced by blending with PCL and the partial miscibility between these two polymers was suggested to cause the promotion of PLA crystallization [10].

In this study, two types of plasticizers vegetable, which are the triethyl citrate (TEC) and the poly (ethylene glycol) (PEG_3), are used as plasticizer to 80PLA/20PCL blend. The aim of this study was to investigate the effects of plasticizers loadings on the thermal, dynamical and rheological properties of PLA/PCL films, as well as, to investigate the interaction between PLA/PCL and plasticizers.

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PA35

Conductive Nanoparticle-Assisted Silver Nanowire Transparent Conductive Film Material

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[Keywords] Conductive nanoparticle, silver nanowire, junction gap, local thermal welding.

As a flexible transparent conductive material, silver nanowire network has attracted the attention of many related scientific researchers. It has been applied in many aspects, such as solar cells, transparent electrodes, sensors, display screens and so on. At present, the surface of the silver nanowire synthesized by the chemical method is covered with an insulating layer, and the local thermal welding between the nanowires has a high requirement for the distance between the nanowires. To this end, we introduce conductive nanoparticles to increase the ratio of weldable junction gaps between nanowires, enabling self-limited welding between nanowires through tip-discharge heating and electromigration or near-field-excitation plasmon resonance heating and field-induced ion migration. This method greatly increases the number of weldable junctions between nanowires by using conductive nanoparticles as mediators, and reduces the resistivity. On this basis, the amount of nanowires can be reduced, thereby reducing the density of silver nanowires and improving the light transmittance effectiveness of the film. This work will make silver nanowires as a more extreme transparent conductive material.

PA36

Synthesis and characterization of polypyrrole coated paper substrate and decorated with silver nanoparticles. Applicationin the electroreduction of nitrate.

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[Keywords] Paper substrate, polypyrrole, silver, nitrate, electroreduction

The main objective of the present study is to elaborate a new electrode material based on polypyrrole deposited on an inert paper substrate and decorated with silver nanoparticles in order to evaluate its electrocatalytic activity for nitrate reduction in alkaline medium. So we report the chemical polymerization of polypyrrole on paper substrate by the use of iron (III) chloride ($FeCl_3$) as oxidant. The silver polypyrrole (Ag/PPy) composite is prepared by simple chemical reduction process from an $AgNO_3$ solution on a previously chemically synthesizedPPy thin films onto the cellulosic sheet. The electrochemical reactivity of the obtained electrodes was studied by voltamperometry technique and electrochemical impedance spectroscopy (EIS). We also describe the effects of duration time of PPy formation and Ag amount incorporated onto PPy films on the catalytic activity. Additionally, the electrode materials were characterized via FTR, XPS, XRD, SEM and EDX as to assess the effect of electrode material on nitrate reduction. The results show that the incorporation of silver nanoparticles into the polypyrrole matrix improves significantly the electrocatalytic activity of this film.

PA37

Comparative Studies Between the Effect of H2O and Methanol On the Growth of Copper Oxide (CuO) Thin Films Deposited by Spray Pyrolysis

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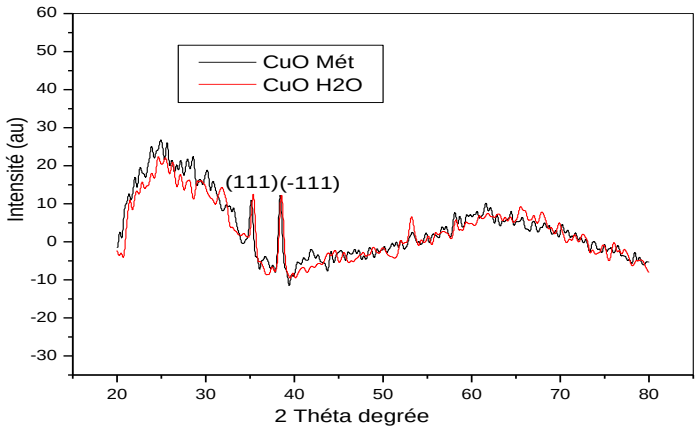
[keywords] Thin films, solvent, cuprous oxide, spray pyrolysis, SEM, XRD.

This work is a comparative study between the effect of H2O and methanol solvents on microstructure, optical and morphological properties of CuO films. CuO films were deposited by the spray pyrolysis method on low price glass at 500°C. Copper nitrate trihydrate has been used as a precursor of cupric oxide dissolved in different solvents (H2O, methanol) with concentration 0.1M. CuO thin films were characterized by using X-ray diffraction (XRD), scanning electron microscopy (SEM) coupled with (EDX) and spectrophotometer UV-Vis. The XRD technique showed two characteristics peak (diffraction plans) (111), (-111) observed on all the elaborated samples that confirms the presence of the CuO monocrystalline phase. The morphological of surface samples analyzed using the scanning electron microscope (SEM) indicates the uniformity of the CuO thin films with a periodic stack atoms having crystallographic planes of minimum surface energy density. the CuO thin films (methanol) are more porous than CuO thin films (H2O).



PA38

Study of Thin films of Nickel Oxide (NiO) Deposited by the Pyrolysis Spray Method

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[Keywords] *NiO*, Thin films, Pyrolysis Spray.

In this work, thin films of nickel oxide (NiO) were deposited by a simple and inexpensive technique, which is pyrolysis spray on ordinary glass substrates heated to a fixed temperature of 500 ° C, from a solution containing nickel nitrate hexahydrate as a precursor dissolved in water with deferent values of concentrations. Nickel oxide (NiO) is an interesting material because of its chemical stability [1], it is a p-type conductivity semiconductor [2], energy bandgap value between 3.6 and 4.0 eV [3] and easy to deposit in thin layers many techniques, such as sol-gel and spray pyrolysis. The NiO thin films obtained were characterized to determine the structure with X-ray diffraction technique (XRD), the absorption domain (UV-Visible Spectroscopy), and the surface morphology (SEM). The X-ray diffraction patterns confirm the presence of NiO phase with preferential orientation along the (111) direction. The optical gap (band gap) for nickel oxide calculated from the measurement of optical absorption is 3.6 eV, which is quite comparable to the value of the ratio.

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PA39

Atomic Layer Deposition and Infrared Transparency Properties of Sc_2O_3 Thin Films

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[Keywords] atomic layer deposition, Sc_2O_3 thin films, infrared transmittance.

Atomic layer deposition (ALD) is a layer-by-layer synthesis method capable of depositing conformal thin films with thickness and compositional control on subnanometer length scales [1-2]. While many materials have been synthesized by ALD [3], studies of Sc_2O_3-based thin films are still absent. Herein, we report an ALD process to synthesize Sc_2O_3, a potentially choice being explored for infrared transmittance. Polycrystalline Sc_2O_3 deposited by atomic layer deposition (ALD) with a subsequent annealing on zinc sulfide and glass substrates is investigated in detail. This ALD process follows saturation behavior typical of ALD systems [4], and the growth rate monotonically decreases with temperature from 100 °C−200 °C, the linear growth rate behavior is no longer seen until 300 °C. Further, the average grain size increases with temperature. Films were stoichiometric with low impurity content. The film thickness was easily controlled with the number of deposition cycles. Sc_2O_3 thin films maintain greater than ∼75% transmittance over a wide wavelength range from 2.5 μm to 12 μm and the highest transmittance value reaches 83.3% at ∼10 μm. The roughness of the films is found to increase both with temperature and cycle number as observed with atomic force microscopy(AFM) and scanning electron microscopy(SEM). The Sc_2O_3 thin films with high infrared transparency in infrared spectral range would be suitable for infrared optical devices.

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PA40

Study the relationship between the damage degree of ITO transparent conducting film and its electromagnetic shielding by Computer Simulation Technology (CST) software

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[Keywords] CST software simulation, ITO, electromagnetic shielding, damage degree

The transparent conducting film is usually used as electromagnetic shielding material. Due to its thin thickness, absorption loss can be negligible. So the shielding effectiveness of the film mainly depends on the reflection loss. Generally speaking, the smaller the sheet resistance of the film, the better the electromagnetic shielding effectiveness. The film's electromagnetic shielding glass surface is coated with one or more layers transparent conductive film to achieve the effect of transparent shielding. Tin doped indium oxide film (ITO), aluminum doped zinc oxide film (AZO), tin oxide film (SnO2) and dielectric/metal/dielectric multilayer transparent conductive film (D/M/D) is generally used as a kind of electromagnetic shielding film [1-2]. ITO transparent conducting film is the most widely used transparent conductive film. It is a kind of transparent conductive film with excellent performance, such as high transmittance，low resistivity and good conductivity. Besides， it has strong adhesion, good wear resistance and chemical stability with the glass and other substrates [3-4].

ITO transparent conducting film is widely used in medical diagnostic equipment, display screen of personal electronic equipment, window of space vehicle, etc. For aerospace craft, once the the electromagnetic shielding films like ITO are damaged, it will seriously affect the performance of the aircraft. So the study on damage degree of ITO transparent conducting film and its electromagnetic shielding is particularly important. In this paper, we used CST electromagnetic simulation software to simulate the influence of different ITO damage degree on the electromagnetic shielding performance of ITO films. The simulation results show that the electromagnetic shielding effectiveness decreases with the area increases. In the 2.6-3.95GHz band, the electromagnetic shielding effectiveness of the film shielding glass is -20dB without damage. When the damage width is 3.4mm and the damage length is 0-28.86mm, there is no obvious effect on the electromagnetic shielding performance of the film. At this time, the shielding effect of the film is about -19 dB. However, when the length of the damage is more than 28.86mm, the electromagnetic shielding effect of the thin-film glass is significantly reduced, and the minimum is -12 dB. In this paper, the relationship between the electromagnetic shielding effect and the damage width of the film is also discussed.

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PA41

Influence of the Physical Properties of SiN_x Deposited Layer on PEEK Support on the Cellular Growth Capacity

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[keywords] polyetheretherketone (PEEK), silicon nitride, biocompatibility.

The surfaces of some polyethertherketone (PEEK) specimens were coated with silicon nitride (SiN_x), without damaging the substrate, using reactive high power impulse magnetron sputtering (HiPIMS) technique, in order to increase the biocompatibility and osteointegration of the polymer. Thin films of SiN_x have been obtained by sputtering a pure Si target in N_2/Ar gas mixture. The properties of SiN_x layers with different N/Si ratios were investigated by, XPS, SEM, AFM, X-ray diffraction analyses, wettability and adhesion tests. The analyzes demonstrate that the SiN_x films obtained on a PEEK substrate has an amorphous structure, whose chemical composition depends on the N2/Ar flow ratios. The SiN_x layer has adhered strongly to the substrate and improved its wettability. The SiN_x -coated samples were evaluated regarding their in vitro cellular behavior and the results were compared with the bare PEEK substrate (uncovered). The level of cell proliferation (MC3T3-E1) and their differentiation level of cells were investigated using the methoxyphenyltetrazolium salt assay (MTS) and the alkaline phosphatase assay (ALP). The comparative study conducted in this work demonstrates that PEEK samples, coated by SiN_x, present a significant increase in cellular proliferation. Thin film deposition of SiN_x on PEEK support obtained through HiPIMS can be considered as convenient solutions for the production of biocompatible materials used in various medical applications.

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PA42

Low Temperature Plasma Assisted Regenerable Antimicrobial Structures on Textile Materials

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[keywords] Antibacterial textile, regenerable antibacterial, n-halamine, plasma surface modification.

Antibacterial textiles are important when producing medical products and at the places where many people spend time like kindergarten, cinema etc. Among them reusable medical textiles are exposed a lot of washing procedures during lifetime. Therefore, wash durability of antibacterial treatment is important. Regenerable systems are an alternative to these products. N-halamine compounds, which are effective biocidals against several bacteria, viruses and fungi, have one or two covalent bonds between nitrogen and halogen molecules. Their antibacterial properties based on electrophilic reactions between chlorine in N-Cl bonds and hydrogen. They are regenerable systems whose chlorine content refilled by treatment with sodium hypochlorite. We worked on the possibility of obtaining regenerable structures by low temperature – low pressure plasma surface modification. Nitrogen containing plasmas (air and ethylenediamine) were used to obtain nitrogen groups on the cotton fabric surface. After plasma treatments, sodium hypochlorite was used for chlorination. Influences of treatments were examined by capillary rise measurements, X-ray photoelectron spectroscopy, measurement of active chlorine concentration, breaking strength and antimicrobial test against *E.coli* and *S.aureus* on the fabrics.

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PA43

Selective etching of LT-GaAs in processing of THz AlGaAs/GaAs quantum cascade lasers

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[keywords] THz quantum cascade lasers, AlGaAs/GaAs structures, LT-GaAs, selective etching

Metallic layers play a dual role in metal-metal waveguide THz quantum cascade lasers (QCLs). Namely, apart from acting as waveguide claddings they are also necessary as metallization of metal-semiconductor (m-s) electric contacts. Therefore, the most often they used to be deposited directly on highly doped semiconductor layers, e.g., on top of n+ GaAs layer when AlGaAs/GaAs QCL structures are involved. At the same time, however, there is some evidence in literature of the subject showing application of low-temperature-deposited (LT) thin GaAs layer on top n+ GaAs, which is supposed to improve the electrical parameters of such m-s contact. On the other hand, there is a risk that presence of a LT-GaAs layer can seriously complicate wafer-bonding process, and that as a result it can also increase waveguide losses of a QCL. This issue motivated us for experimental comparison of results of processing of an AlGaAs/GaAs THz QCL structure with LT-GaAs left untouched versus the same structure after the LT-GaAs removal. Consequently, elaboration of LT-GaAs layer removal process was necessary. In this work we describe selective etching of a 3.5 nm-thick LT-GaAs layer deposited at the temperature of 250^0C by molecular-beam epitaxy over a 10 nm-thick highly doped GaAs:Si. Buffered HF mixture (NH_4F:HF:H_2O 7:2:1) was used for the etching. In particular, special test structures were elaborated which allowed for evaluation of the etching rate (which typically was ≥ 0.65 nm/s). The samples were characterized by atomic force microscopy and optical microscopy.

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PA44

Structural and Mechanical Properties of Mo_2N/CrN Multilayers Deposited at 600°C by DC Magnetron Sputtering

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[Keywords]: Mo_2N/CrN; Multilayer; X-ray diffraction; Nanoindentation.

The multilayer films Mo_2N/CrN were deposited by reactive magnetron sputtering at 600°C on Si substrates with different bi-layer periods λ ranging from 5 to 50 nm. X-ray diffraction (XRD), atomic force microscopy (AFM) as well as scanning electron microscopy (cross section images) and nanoindentation measurements were used for investigations of structure, microstructure and mechanical properties of the multilayer coatings. X-ray diffraction shows that the films Mo_2N and CrN present a face centered cubic structure with columnar growth as well as the multilayer coatings are well crystallized with (200) preferred orientation texture in the plane of Mo_2N. As the bi-layer period was decreased the grain size increases from 14 to 20 nm and the surface roughness (RMS) decreases of CrN top layer. The nanohardness measurements show that the mechanical properties of Mo_2N/CrN multilayers depend on the bi-layer period following the mixture rule. The highest value of 29 GPa was obtained at the bi-layer period of 10 nm.

PA45

The Effect of Deposition Parameters on the Wear and Scratch Properties of TiAlZrN Coatings

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[keywords] Wear, Magnetron Sputtering, Graded Composite Coating.

In this study, it was investigated the scratch and wear resistance of heat treated AISI H13 (X40CrMoV5-1) hot work tool steel coated with TiAlZrN. Before deposition process, the surface of the steel substrates were nitreded to enhance scratch resistance of coatings. Pulsed DC closed field unbalanced magnetron sputtering method were used as a deposition methods for application of coatings. Deposition parameters for this coating were designated by using Taguchi experimental design method. The coatings thickness and morphological properties of these coatings were investigated using scanning electron microscopy. The wear experiments of coated samples were conducted by a high temperature ball on disk tribotester. Thereafter, the wear volumes were analyzed by an optical profilometer. The acquired results showed that the TiAlZrN-graded composite coatings have 2-3 μm thickness and a dense and columnar structure. Wear resistance tests showed that the highest wear strength was attained at 5 A Zr target content, 90 V bias voltages and $2x10^{-3}$ Torr working pressure deposition parameters. Besides, this coating exhibited the highest scratch resistance (79N) compare the other coating samples.

PA45

Roll-to-Roll Production of Layer-Controlled Molybdenum Disulfide: A Platform for 2D Semiconductor-Based Industrial Applications

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A facile methodology for the large-scale production of layer-controlled MoS2 layers on an inexpensive substrate involving a simple coating of single source precursor with subsequent roll-to-roll-based thermal decomposition is developed. The resulting 50 cm long MoS2 layers synthesized on Ni foils possess excellent long-range uniformity and optimum stoichiometry. Moreover, this methodology is promising because it enables simple control of the number of MoS2 layers by simply adjusting the concentration of (NH4)2MoS4. Additionally, the capability of the MoS2 for practical applications in electronic/optoelectronic devices and catalysts for hydrogen evolution reaction is verified. The MoS2-based field effect transistors exhibit unipolar n-channel transistor behavior with electron mobility of 0.6 cm2 V−1 s−1 and an on-off ratio of ≈10³. The MoS2-based visible-light photodetectors are fabricated in order to evaluate their photoelectrical properties, obtaining an 100% yield for active devices with significant photocurrents and extracted photoresponsivity of ≈22 mA W−1. Moreover, the MoS2 layers on Ni foils exhibit applicable catalytic activity with observed overpotential of ≈165 mV and a Tafel slope of 133 mV dec−1. Based on these results, it is envisaged that the cost-effective methodology will trigger actual industrial applications, as well as novel research related to 2D semiconductor-based multifaceted applications.

POSTER SESSION B

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PB01

Optimization of the absorbent layer CISe deposited on the glass substrate by Spray pyrolysis

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[keywords] CISe, Glass substrate, Substrate temperature, Solar cells

Currently, chalcopyrite solar cells are increasingly imposed in the photovoltaic market, thanks to its performances comparable to that based on silicon [1], also the cost of elaboration which represents a very important parameter in Industry, for this purpose, this study is interested in the elaboration of the absorbent layer CuInSe2 by a less expensive technique "Spray Pyrolysis"[2], the CISe deposits were carried out on Sodo-Calcium substrates under a Argon pressure of 2Bar, a temperature variation was proceeded at 450 ° C, 500 ° C, 550 ° C, for a time of 10 min, the Diffraction of x-ray mounted the presence of four peaks, indexed as (112), (220), (400) , and (424) according to the JCPDS 23-0209 file of chalcopyrite. This peaks confirms the polycrystalline structure films, the temperature influence appeared in the peak (112), we remark than the intensity of peak this peak improve with the increase in temperature, and its diffraction angle 2θ changes towards the preferential position, We notice A decrease in the I (220) / I (112) ratio, confirming a good orientation for CISe-3 at 550 ° C, the chemical report Cu / In for all films presents the values of 1.8 and 1.9, however, a Na signal is noticed in the CISe layer, the films have good optical absorption, especially in the visible range. A relative better absorption is obtained at TS = 550 ° C.

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PB02

Determination of Ag-S interface of L-cysteine on silver surface

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[keywords] L-cysteine, Silver, Interface, UPS, XPS.

Among the amino acids, the sulfur containing L-cysteine ($HS–CH_2–CH(NH_2)–COOH$) has been received more attention as the most useful amino acid to create bioactive surfaces *via* bond proteins to metal surfaces. In the case of L-cysteine interaction with metalic partners such as gold, silver and copper, the SH group of L-cysteine is known to interact strongly with the metallic surface and binds metallic surface mainly employing SH functional group [1]. The interaction of the L-cysteine with silver surfaces is particularly interesting because, L-cysteine adsorption on silver has been suggested to be stronger than on gold or copper surfaces [2] and the interactions may strongly influence the formation of novel interface states of the L-cysteine-Ag interface. However, research has not been sufficiently addressed to investigate the L-cysteine-Ag interface inorder to understand the interface electronic structure.Therefore, we have studied electronic structure of L-cysteine and silver interface by thickness dependent ultraviolet photoelectron spectroscopy (UPS) and x-ray photoelectron spectroscopy (XPS). Further, we have also performed near-edge x-ray absorption fine structure (NEXAFS) of L-cysteine on silver surfaces in order to support UPS & XPS analysis.

The UPS measurements were carried out at the beamline BL2B of the Ultraviolet Synchrotron Orbital Radiation (UVSOR) facility of the Institute for Molecular Science, Japan. The XPS and NEXAFS were carried out at the BL 27A soft x-ray station in the Photon Factory of the High Energy Accelerator Research Organization (KEK-PF), Japan. In this study, L-cysteine films on silver surfaces were formed by vacuum evaporation of L-cysteine powder. A set of subsequent UPS measurements was performed for thickness dependent UPS analysis. In the case of XPS and NEXAFS measurements, several films from around monolayer coverage were prepared and subsequently, a set of XPS and NEXAFS measurements was performed at each step of the thickness accumulation. The thicknesses of the films were estimated by the wide XPS mesurements. In UPS results, a clear spectral feature in between the Fermi level of silver and the HOMO of L-cysteine was observed for thin films. This feature can be attributed to an interaction of a sulfur-originated state of L-cysteine HOMO interaction with Ag d orbitals. In XPS results, clearly two peaks of 6 eV shift were observed in S 1*s* for monolayer film. This can be attributed for molecular L-cysteine and the formation of Ag-S configuration between sulfur and silver atoms. On the other hand, only a peak was observed for multilayer films. A spectral change at lower energy region was also observed in S K-edge NEXAFS spectra compare with monolayer and multilayer coverage.

* The UPS experiments were performed under the approval of the Joint Studies Program (25-562) of the Institute for Molecular Science, Japan. XPS and NEXAFS were performed by the approval of KEK-PF (Proposal No. 2015 G068).

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PB03

Seed-Mediated Growth of Metallic Nanostructures on End-grafted Polymer Thin Films

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[keywords] Metallic nanostructures, end-grafted polymer films, Au-Ag nanostructures, Pt-Ag nanosutructures, Au-Ag-Pt nanostructures

Due to their unique optical, catalytic and electronic properties, noble metal nanoparticles (NPs) such as Au, Ag, Pt and Pd are of significant interest in applications including sensing, catalysis, and electronics [1]. Integration of lithographic templates with physical vapor deposition techniques allows for patterning of metallic nanostructures with unprecedent spatial control; however, the resulting structures are generally polycrystalline and the processing costs are prohibitively high. In this contribution, we present on-surface growth of metallic nanostructures on solid substrates modified with end-grafted polymers. Thin (<15 nm) films of poly(ethylene glycol) and poly(2-vinylpyridine) enable tunable immobilization and assembly of seed nanoparticles [2]. Surface-confined growth on top of the immobilize seeds allow for low-cost, scalable and versatile fabrication of metallic nanostructures. Figure1 presents Ag and Pt nanostructures that were grown on top of the immobilized gold nanoparticles using a seed selective reducing agent. Metallic nanostructures were structurally characterized by SEM, XRD and EDX. The resulting nanostructures exhibited rich optical and catalytic properties as evidenced by surface-enhanced Raman spectroscopy and degradation of dye molecules.

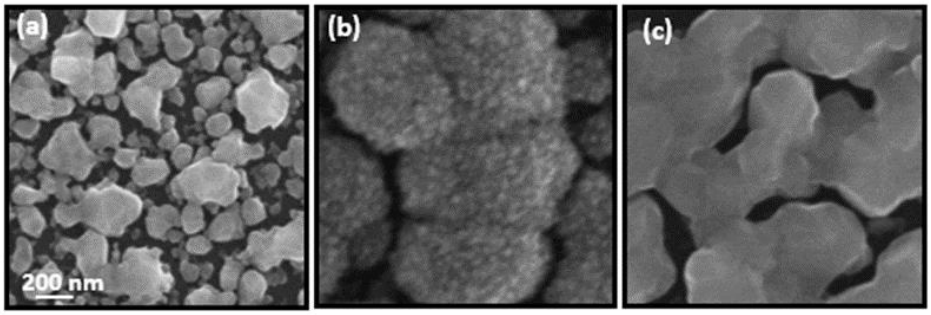

Figure 1.SEM images of the grown a) Au-Ag nanostructures, b) Au-Ag-Pt nanostructures, c) Pt-Ag nanostructures.

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PB04

Hydrothermal synthesis of $ZnCo_2O_4$ electrode material for supercapacitor applications

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[keywords] $ZnCo_2O_4$ nanowires, supercapacitor, nickel foam and hydrothermal method.

In order to meet the increasing demand for energy in our daily lives, the need for energy storage devices is increasing day by day. Supercapacitors are capable of meeting these requirements owing to their high power density, long-term cycling stability, fast charge rate and safe operating mode [1–5]. Recently, transition metal oxides (two different transition metals A and B; Co, Mn, Ni, and Zn) have been widely explored due to the synergistic effect between the two metal elements with different chemical valence. For instance, spinel-type $ZnCo_2O_4$ nanostructures has been researched for not only Li-ion batteries, electrocatalysts and sensors but also supercapacitors applications [6–9]. Therefore, in this work, we were investigated the supercapacitor properties of $ZnCo_2O_4$ nanowires synthesized on 3D-nickel foam by hydrothermal method. Structure, morphology and elemental analysis of the $ZnCo_2O_4$ nanowires were carried out using the X-ray diffractometer technique (PANalytical Empyrean, Cu-Kα, λ=1.54060 Å), a field-emission scanning electron microscope (FESEM: FEI Quanta 450 FEG) and an EDS analyzer in the FESEM system (EDAX, AMETEK Materials Analysis Division) respectively. Cyclic voltammetry (CV), galvanostatic charge discharge (GCD) and electrochemical impedance spectroscopy (EIS) analysis of the $ZnCo_2O_4$ nanowires were performed via Gamry Reference 3000 potentiostat in 1 M of a KOH aqueous electrolyte solution.

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PB05

Numerical Solution to KPZ Equation for Radial Interfaces

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[keywords] Surface growth, KPZ equation, Radial geometry.

The interface growth dynamics has attracted big amounts of interest in the last decade to describe variety of problems like fluid flow in porous media, propagation of flame fronts, deposition processes and also biological systems [1]. These can be studied by continuous stochastic partial differential equations like Edward-Wilkinson [2] and Kardar-Parisi-Zhang equation [3]. In a group of problems like tumor and also bacterial growth, the standard form of these equations should be modified according to the different geometry and symmetries. In 2008, Escudero claimed that changing geometry leads to different scaling properties in growing interfaces [4]. Later, others asserted that the scaling properties are equivalent in planar and radial geometries [5,6]. Here, we show numerically that by converting the growth equation from planar geometry to the radial geometry, the interfaces evolve differently as predicted by Escudero. We use implicit Finite Difference Method to solve (1+1) KPZ equation.

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PB06

CVD Graphene Contact Electrode for ZnO/Graphene based photodetectors

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[keywords] Photodetection, Ultraviolet; ZincOxide, Graphene Electrode, Chemical Vapor Deposition, Pulsed Electron Deposition

In this work, we present fabrication and characterization ZnO/Graphene based photodetector in ultraviolet region. ZnO is growth using Pulsed Electron Deposition (PED) method and graphene is growth in a controlled manner by Chemical Vapor Deposition (CVD) method. Monolayer CVD graphene transferred onto lightly doped Si substrate is interdigitated as transparent conductive electrode to probe photo-generated charge carriers in Si substrate. The resulting current-voltage characteristics exhibit rectifying behavior due to Schottky junction at the interface between CVD graphene and ZnO semiconductor. [1] The fabricated device behaves the typical current-voltage characteristics of a metal-semiconductor-metal type photodetector with low leakage current. [2] Dark current and photocurrent as a function of bias voltage and time-resolved photocurrent characteristics of the device were investigated. Under specific UV light illumination time response characteristics of the device demonstrated that the fast photoresponse is maintained at different bias voltages. The light on/off characteristics of the device showed that ZnO/Graphene heterojunction can be used for UV photo-detection. Further optoelectronic measurements offered ZnO/Graphene based photodetector responses the UV light illumination with good reproducibility. The results obtained which indicates that ZnO is the most promising candidates for UV photodetectors and CVD graphene can be used as transparent conductive electrode for Si based optoelectronic device applications.

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PB07

Mesoporous $NiCo_2S_4$ nanostructures grown on 3D graphene-nickel foam for supercapacitor applications

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[keywords] $NiCo_2S_4$ nanostructures, supercapacitor, 3D graphene-nickel foam and CVD

Electrical energy storage and conversion systems play a vital role in the efficient and cost-effective utilization of clean energy from renewable sources [1]. In particular, electrochemical energy storage and conversion devices such as batteries, fuel cells, and supercapacitors are considered the most promising candidate for portable and mobile applications. Among them, supercapacitors have advantages due to their long-term cycling stability, safety operation mode and high power output [2]. The energy storage properties of the supercapacitors mainly depend on electrode materials, electrolytes and separators [3]. Improvement in electrode materials have been affected the electrochemical performance of supercapacitors positively. Nano-sized (0D, 1D, 2D and 3D) electrode materials not only increase the surface area but also increase the active sites between the electrode material and the electrolyte solution and shortens the ionic diffusion paths during the reaction [1,4,5]. Recently, 3D architecture substrates (nickel foam, graphene foam) with numerous pores have been widely investigated for supercapacitor electrodes. Among these substrates, 3D graphene skeleton possesses excellent cycling stability and high power density due to electrochemical double-layer capacitor performance of graphene [5]. Graphene has been used as ideal matrix to anchor electroactive pseudocapacitive ternary metal sulfide composites to improve the performance of supercapacitors [6,7]. The excellent synergistic effect between the graphene layers and ternary metal composites leads to improved specific capacitance, rate capability and cycling stability [6]**.** Therefore, in this study $NiCo_2S_4$ nanostructures were synthesized on 3D-graphene nickel foam substrate by two step processes, namely, CVD (chemical vapor deposition) method and hydrothermal reaction to produce graphene and $NiCo_2S_4$ nanostructures respectively and used it as electrode for supercapacitors.

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PB08

Spectral Artificial Diamond Growth and Boron doped by HFCVD method to use in bits

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[keywords] boron doped diamond.

The first synthetic method for artificial diamond is called high pressure, high temperature (HPHT). Tiny anvils in an HPHT machine squeeze down on the graphite as intense electricity zaps it, producing a gem-quality diamond in just a few days. The other diamond-producing method called chemical vapor deposition (CVD). In this method by using suitable catalyst deposit on a substrate then start to growth

Polycrystalline (or single crystal) diamond growth on surface by continuing deposition the size of crystals raise also adding some elements inside the diamond you can change the properties one of the most important element is Boron atoms. The boron can substituted in diamond lattice and make it to a super hard materials with hardness (GP 80≥) in this research we growth boron doped polycrystalline diamond (BDD) to make super hard material for bit application for Petroleum / Geology Industry. To analysis physical and chemical properties we used FESEM fig (1), RAMAN, Vickers hardness test, XRD, AFM. Raman analysis revealed peak around 1330 cm-1 which is originate from diamond poly crystalize and also AFM and FESEM shows diamond polycrystalline on substrate surface on the other hand XRD shows some sharp peaks which come from diamond structure. This properties make it suitable for use to make BIT at Petroleum / Geology Industry.

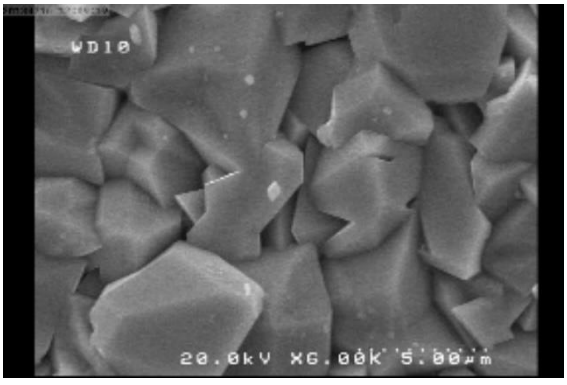

Figure (1) boron doped polycrystalline diamond

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PB09

Optical Characterizations of PVA/Porous SiC powder based Composite Thin Films

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[keywords] Porous SiC micropowder; PVA; thin films, optical characterization

Over the years, polyvinyl alcohol (PVA) polymers have attracted attention due to their variety of applications. PVA is a potential material having high dielectric strength, good charge storage capacity and dopant-dependent electrical and optical properties. It has carbon chain backbone with hydroxyl groups attached to methane carbons; these OH groups can be a source of hydrogen bonding and hence assist the formation of polymer composite [1]. The crucial factors for the use of a semiconducting material as an active layer in the solar cells are the band gap and optical absorption of the material. The relatively large band gap of polymer such as PVA limits the absorption of near-infrared light and thus lowers the light harvesting and therefore cannot be used as an active layer in solar cells [2]. The control over the band gap is necessary while designing new materials for solar cells. The band gap engineering allows one to design and synthesize new materials with maximum overlap of absorption spectrum with the solar emission spectrum. In the present work, we prepared and characterized the PVA polymer thin films with and without the inorganic porous SiC particles to produce composite thin films with suitable energy band gap which matches with the solar energy spectra [3].

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PB10

Study of interface induced structure and magnetic properties of Gd/Co multilayer films

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[keywords] magnetic multilayer film, polarized neutron reflectivity, compensation temperature.

Rare-earth (RE)/transition metal (TM) ferromagnetic multilayers are interesting as model systems for studying the exchange interaction between TM and RE metals, where the magnetic state is determined by a competition between the Zeeman energy and antiferromagnetic (AF) interfacial exchange coupling energy [1-5] hence this AF interlayer coupling represents a ‘‘giant’’ or artificial ferrimagnet. These ferrimagnetic alloys and multilayers are of great interest fundamentally as well as from a technological point of view. In this paper we studied interface induced structure and magnetization in Gd/Co heterostructures using the combination of structural and magnetic characterization techniques. The interface morphology of the Co/Gd system was varied by growing Co/Gd multilayers under different argon partial pressures. Interfacial properties were further modified by annealing the multilayers under high vacuum. The macroscopic magnetization measurements (SQUID data) have been correlated with depth dependent structure and magnetic properties of multilayers studied using x-ray reflectometry (XRR) and polarized neutron reflectivity (PNR). Secondary ion mass spectrometry (SIMS) measurements from as-deposited and annealed samples confirm modification at interfaces, as obtained from XRR and PNR. It is shown that the interface structure together with roughness lead to unique low-temperature magnetic phases characterized by twisting of Gd and Co magnetic moments

In contrast to earlier studies, our results show that the Gd layers are grown with polycrystalline fcc structure, which might have helped to grow high quality of multilayer structure without alloy layer formation during deposition. The findings of depth dependent structures especially interface morphology, using XRR and PNR are very well corroborated with the SIMS measurements. We have shown that the compensation temperature (T_{comp}), which is direct signature of interface exchange interaction of Co and Gd at interfaces, strongly correlated to the interface morphology and T_{comp} increases with increase in interface roughness. Correlation of structure-magnetic properties of multilayers annealed at 200 ^{0}C confirms the dependence of T_{comp} on interface roughness. Further annealing of the multilayers at 300 ^{0}C and 400 ^{0}C resulted into formation of alloy at interfaces which provided extra coupling for interface exchange interaction and therefore additional magnetic disorder phases in the systems at low temperature were observed. These results offer valuable information to help us understand the mechanisms of interface induced magnetization in RE/TM system.

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PB11

Investigament of Atomic Force Microscopy and Optical Properties of Graphene Nanowalls (GNWs)

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[keywords] Graphene nanowalls (GNWs), AFM, optical properties.

In this study, graphene nanowalls (GNWs) have been deposited on glass substrate by pulsed filtered cathodic vacuum arc deposition (PFCVAD). A high purity graphite rod was used as a cathode target. Dependence on the distance between the target and the substrate on the surface properties and optical properties of graphene nanowalls were investigated by means of atomic force microscopy (AFM) and UV-Vis-NIR spectroscopy.

The surface properties of films have an important role on their optical and electrical properties. In this study, the surface properties of the films is characterized by atomic force microscopy (AFM). We presented our results of C-AFM (Contact-AFM) measurement on GNWs. Graphene nanowalls were seen while the distance between substrate and target was about 1 and 2 cm.When the distance between substrate and target was about 3 cm, the nanowalls were not seen. Standard deviation of the height value (Rq) and average roughness (Ra) defined as roughness statistical parameters are 19.718 nm, 7.911 nm, respectively. Absorbance and transmission spectra of the films were measured at a wavelength range of 350–700 nm, by using a Varian Cary 5000 model UV–Vis–NIR. The absorption coefficient was determined from absorbance spectra. With increasing distance between the target and the substrate, it has been observed that the optical properties of the GNWs films change.

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PB12

Fabrication of Silicon nanowire/Cu_2O nano-heterojunctions by electroless deposition technique for photodegradation of methylene bleu in visible light

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[keywords] Si NWs/Cu_2O , nano-heterojunctions, nanocrystallines, Photocatalytic activity,Visible light.

We report a simple method to produce Si NWs/Cu_2O nano-heterojunctions by electroless deposition to deposit CU2O nanocrystallines on the surface of silicon nanowire arrays (Si NWs). morphological features and chemical composition of the nanocrystallines were characterized using X-ray photoelectron spectroscopy (XPS), Fourier transform infrared (FTIR) spectroscopy, X-ray diffraction (XRD), scanning electron microscopy (SEM). The optical properties of the nanocrystallines were examined using UV–visible (UV–vis) spectrophotometry. The photocatalytic activity of the Si NWs/Cu2O was evaluated for the degradation of a model organic pollutant, methylene bleu, under visible light irradiation at room temperature. The highly efficient photodegradation capability of the nanocrystallines was demonstrated by comparison with Si NWs alone and Si NWs/Cu_2O for different time durations of deposition of Cu_2O, prepared using identical experimental conditions. Overall, the present approach adheres to green chemistry principles and the nanocrystallines holds promise for the development of remarkably efficient catalytic systems. The degradation of dye effluents has received a large attention recently [2, 3]. Indeed, it is an essential need to develop novel treatment methods for converting these organic dyes to harmless compounds in terms of the increasing public concern and the stringent international environmental standards (e.g., ISO 14001) [1].

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PB13

Investigation of Structural and Mechanical Properties of DLC Thin films in Reduction Atmosphere

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[Keywords]: DLC Thin Films, FESEM, XPS, RAMAN

Diamond like Carbon (DLC) thin films were deposited by chemical vapour deposition by using C2H2 and H2 as precursor gases on SiO2/Si substrate. The structural and mechanical properties of DLC thin films were characterized by Field Emission Scanning Electron Microscope (FESEM), Raman spectroscopy, X-ray photoelectron spectroscopy (XPS) and nanoindentation. The FESEM image reveals the smooth surface consists of DLC thin films while nanocluster formation at a higher H2 flow rate. The Raman spectra of DLC thin films reveals ID/IG and carbon clusters were varied from 1.03 to 1.52 and 13 to 8.56 nm respectively. The maximum hardness and Young's modulus are 22.46 GPa and 193.97 GPa for the H2 flow rate of 20 sccm respectively. Furthermore, increasing of the H2 flow rate deteriorated the hardness and Young's modulus of DLC thin films. The binding energy of C (1s) core orbital spectra shifted from 284.77 to 285.14 eV with increasing of H2 flow rate. Moreover, deconvolution and the analysis of core orbital C(1s) spectra were carried out by Origin 9.0 software.

PB14

Influence of Oxygen Flow Rate on the Spraying of Aluminum Oxide (Al_2O_3) for Silicon Surface Passivation

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Keywords: Spray ultrasonic, aluminum oxide, negative charges, oxygen flow rate, surface passivation

Spray ultrasonic method has been shown to be capable of depositing aluminum oxide (Al2O3) suitable for surface passivation but the mechanisms for achieving this remain to be further established. In this contribution, we study the influence of oxygen flow rate in the spray process to the resulting interface properties and the surface passivation obtained. Ours results indicate that the surface passivation is strongly dependent on interface properties. It was found that these properties after annealing between the aluminum oxide film and the silicon is a much more important factor; it is this combined structure of aluminum oxide, silicon oxide and silicon that is crucial for obtaining more of negative fixed charges and good surface passivation.

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PB15

Influence of substrate bias voltage of titanium oxynitride coatings deposited by PVD on the structure, composition and properties

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[Keywords]: Magnetron sputtering, TiNxOy, 316L, Bias voltage.

TiOxNy films were grown onto 316L stainless steel substrate using radiofrequency (rf) magnetron sputtering from a pure titanium nitride target in Ar-O2 gas mixture with various substrate bias voltages. The aim of this work is to investigate the effect of applied substrate bias Vs, varied from 0 to −100 V, on the deposition rate, structure, hardness and optical properties of the TiNxOy films. The characterization of the coatings by Grazing Incidence X Ray Diffraction exhibited a crystalline structure of a mixture of TiN, rutile and anatase. The indirect and direct bad gap were found to decrease for unbiased substrate voltage to Vs = −100 V from 3.84 to 3.20 eV. In addition, the coatings exhibit high transparency (transmittance over 80%). The hardness of the coatings was found in the range of 6.2 to 12.5GPa.

PB16

The Effect of Dislocation Density on the Penetration of Au from the Metal Contact into GaN

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[keywords] ohmic contacts, GaN, Au, diffusion

The performance of low-resistivity, stable ohmic contacts to gallium nitrides still remains quite a challenge. Also, the reproducibility and surface morphology of the semiconductor are far from satisfactory as the contact formation requires sufficiently high temperatures. In general, making low-resistance ohmic contact is difficult for wide bandgap semiconductors, especially for p-type GaN due to the limitations in adequate doping. Gold is being widely used, for its inertness and excellet conductivity, as a component of nearly all the investigated and fabricated multi-metal structures comprising elements with different work functions such as Pd, Pt, Ni, Ti, or Cr. Generally, the interaction of Au-containing metallization with the GaN substrate can be classified into three categories: (i) chemical reactions involving elements of both GaN and the contact constituents, (ii) classical interstitial or substitutional diffusion in the crystal (iii) migration through imperfections, cracks and grain boundaries. We postulate that the main driving force for Au penetration deep into the crystal is its ability to form, with gallium released from the decomposition of GaN, solid solutions, eutectics and β-phases with a high negative enthalpy of formation. Gallium is known as an extremely fast diffuser in Au, even at room temperature [1]. The role of the crystal dislocations that eventually act as paths (or pipes) of fast diffusion [2] was inferred from a comparative study of Au concentration profiling taken on GaN layers MOCVD-grown on sapphire and on a bulk gallium nitride synthesized by the ammono-thermal method. The dislocation density between the two materials differs by a factor of 10^4. The applied analytical techniques were RBS, SIMS and X-ray diffractometry.

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PB17

Preparation, growth, microstructure and optical properties of nonvacuum Cu/Co co-doped ZnO thin films

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Preparation, growth, and microstructure Cu/Co co-doped ZnO thin films were studied. Zn1-xCu0.01CoxO (x=0.0, 0.01, 0.02, 0.04, and 0.05) precursor solutions were prepared by sol-gel synthesis using Zn, Cu and Co based alkoxide which were dissolved into solvent and chelating agent. Cu/Co co-doped ZnO films have been deposited onto glass substrate by using sol-gel dip coating system. The doping ratio effect on microstructure and optical properties were investigated. The crystal structures and surface morphology of the Cu/Co-doped ZnO thin films were characterized using 2θ-θ x-ray diffraction (XRD)) and Scanning Electron Microscope (SEM). Optical properties of the Cu/Co-doped ZnO thin films were investigated by UV-Vis. Spectrometer. The microstructure and optical properties of different doping ratio process were presented.

PB18

Ion Implantation Several-µm-Deep Electrical Isolation in AlGaAs/GaAs Quantum Cascade Lasers

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[keywords] H^+ implantation, electrical isolation, GaAs, AlGaAs/GaAs, QCL, RBS\c

Device processing of quantum cascade lasers (QCL) requires restriction of the lateral current spreading, which can be achieved by several technological solutions. The most popular one is the formation of mesa structures [1], which imposes need of depositing dielectric layers on the mesa ridge and hence can introduce optical losses. An alternative approach is presented in this work, involving high energy ion implantation through appropriately elaborated mask. This allows for the area-selective formation of highly resistive regions, which leads to both the current spread suppression and radiation confinement (in the case of plasmon-based waveguide). We have shown a successful employment of hydrogen implantation isolation to the depth > 6 µm, for the MIR (~9.5 µm) $Al_{0.45}Ga_{0.55}As$/GaAs plasmon-enhanced-waveguide QCL [2]. The isolation was performed using 640 keV H^+ hydrogen implantation to a fluency of 1×10^{15} cm^{-2}, whereas unimplanted regions were masked with 4 µm thick metallic mask made mainly of gold, which was left after the implantation and further used as a contact layer.

H^+ implantation isolation instead of mesa implantation reduces the number of technological steps significantly and allows for a device construction that results in better heat dissipation. Moreover, it allows for the formation of highly resistive regions with good precision to the depth of even up tens of micrometers. Crucial issue is the design of the masking layer that effectively stops the highly energetic ions, as well as the possible lateral isolation under the stripes of masking layer.

Theoretical simulations and experiments were conducted in order to establish the optimal parameters, like the ion energy, dose, and masking layer material and thickness, and to verify the implantation isolation [3]. We obtained the sheet resistivity of the fabricated isolating regions R_{SH} of $(1.5 \pm 0.9)\times10^9$ Ω/□, which was stable up to the annealing temperature of 310 ℃ for 1 minute. The QCL device fabricated with this isolation scheme operated with threshold current densities of 6 kA/cm^2 at the temperature of 77 K. Ultimately, we confirmed the applicability of hydrogen implant isolation for the manufacturing of optical devices.

A similar scheme for electrical isolation was designed for the THz-(~100 µm) $Al_{0.45}Ga_{0.55}As$/GaAs plasmon-enhanced waveguide QCL. It utilizes ≳ 900 keV H^+ implantation for the 10 µm-deep isolation, with 5 µm thick masking layer made of gold.

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PB19

Design, fabrication and characterization of high voltage AlGaN/GaN-on-Si HEMTs with various field-plate structures

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[keywords] AlGaN/GaN-on-Si, HEMT, high electron mobility transistor, power electronics

AlGaN/GaN High Electron Mobility Transistors (HEMTs) are capable of achieving a high breakdown voltage, small losses and large switching speed due to the excellent properties of III-N materials. Moreover AlGaN/GaN heterostructures can be grown on large diameter, low cost silicon (111) substrates allowing high volume production of power devices. The one of the main problems with development of AlGaN/GaN-on-Si power devices is proper management of electric field-distribution under high voltage off-state conditions. To enhance breakdown voltage several approaches have been developed. Among them application of various field-plate structures in order to reduce the peak of electric field at the vicinity of drain-side of gate electrode edge seams especially attractive due to relatively easy integration into fabrication process without reducing the specific on-resistance.

Here in this work we presents results of fabrication and characterization of high voltage AlGaN/GaN-on-Si HEMTs with various single and double field-plate structures with geometry optimized using technology computer-aided design (TCAD) simulation. The use of gate and drain double field plates allowed to realize AlGaN/GaN-on-Si HEMTs with breakdown voltage over 1100V, wherein the mutual relation of their parameters, V_{BR} and R_{on}, does not differ from the best values presented in the literature. The experimental value of figure of merit ($FOM=V_{BR}^2/R_{on}$) obtained in this work, is achieved in case of devices on silicon substrates fabricated by most experienced research groups in this field. We also presents experimental realization and comparison of the devices with source field-plates fabricated on AlGaN/GaN-on-Si heterostructure with GaN-cap or in-situ SiN-cap. We also shown the results of TCAD simulation and development of AlGaN/GaN-on-Si HEMTs with atomic layer deposited Al_2O_3 as a passivation layer integrated with source field-plate structures.

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PB20

Growth and Characterization of ZnO Nanostructures on Porous Silicon Substrates: Effect of Current Density

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[keywords] ZnO nanostructures, Porous silicon, Electrodeposition, Current density.

Metal oxide semiconductor materials are very important for optoelectronic device applications. Especially, Zinc-oxide (ZnO) has wide band gap of 3.37 eV and high exciton binding energy of 60meV at room temperature [1]. ZnO is a natural n-type semiconductor with hexagonal wurtzite crystal structure. The ability to adjust the structural and optical properties of the zinc-oxide (ZnO) material to the desired applications is an important advantage and makes it interesting for material science. There have been used a variety of methods to produce ZnO nanostructures such as thermal evaporation, chemical vapour deposition, sol-gel, chemical bath deposition and electrochemical deposition. Recently, electrodeposition has the advantage of simplicity, low cost and width of parameter space [2].

In this study, firstly, porous silicon substrates obtained on n-type Si(100) wafers by anodization method. Porous silicon layers quite suitable for the deposition of ZnO nanostructures because of its strong absorbability, high resistance and large surface area [3]. Secondly, ZnO nanostructures were successfully grown on porous silicon substrate by electrochemical deposition (electrodeposition) method. ZnO deposition on the porous silicon substrates was carried out three different current density (0.1mA - 0.5mA - 0.9mA) and at 95°C solution temperature. The effect of current density on the growth of ZnO nanostructures were systematically characterized by X-ray diffraction (XRD), Scanning Electron Microscopy (SEM), Photolüminesans (PL), and Raman spectroscopy. The XRD diffraction peaks show a polycrystalline nature of ZnO nanostructures. Strong and sharp ZnO (002) peaks indicate the preferred orientation growth of the ZnO nanostructures which move toward the c-axis. The XRD peaks which have strong intensity and narrow width show good crystallinity of the as-grown ZnO nanostructures. Scanning electron microscopy (SEM) results showed that rough nanoporous surface play an important role in the formation of ZnO flower-like nanostructure. Photolüminesans (PL) ve Raman analyses proves that the aligned nanoflower structures exhibited the typical emission peaks in the UV and visible regions. Furhermore, the ZnO nanoflower-like structures which grew at 0.5 mA current density and 95°C solution temperature resulting in high structural and optical quality. These ZnO nanostructures can be potantial used it fabricating nano-electronic and nano-optical devices [4].

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PB21

Effect of Deposition Pressure and Power on the Perpendicular Magnetic Anisotropy in Hf/CoFeB/MgO Multilayer Structure

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[keywords] Spin-Orbit Torque, Spintronic, Magnetic Tunnel Junction, MRAM.

The magnetic anisotropy in ultra thin magnetic multilayer structures has an important place in magnetic random access memory devices due to its density effect for capacity of memory. Writing the data as perpendicular to the devices rather than in-plane anisotropy could increase the capacity of the magnetic memory devices. The typical free part of magnetic tunnel junctions is composed of metal/ferromagnet/insulator where the metal layer is heavy metal such as Ta, W, Hf, Pt [1-5] for spin-orbit torque devices. Selecting of material in all three layers, ferromagnetic layer thickness, insulator material and its thickness and annealing temperature could affect the magnetic anisotropy of ultra-thin ferromagnetic layer [5]. Therefore, we have studied the effect of deposition parameters, such as power and pressure, on magnetic anisotropy in Hf(5.0)/CoFeB(1.0)/MgO(2.0) multilayer structures grown by magnetron sputtering system (thickness in nanometers). We used various combination of power and pressure during growing process of multilayer structures. After the deposition of multilayer films, they were annealed to enhanced perpendicular magnetic anisotropy property. For quick analysis, we used magneto-optical Kerr effect system to understand the quality of magnetic anisotropy. It is observed that the perpendicular magnetic anisotropy is directly related to the power of target and process pressure in the chamber. We have found that the magnetic anisotropy in such structure might enhance by lowering pressure and target power as 2 mTorr and 80W, respectively. In the presentation, we will give the detail results of deposition parameters effect on perpendicular magnetic anisotropy and film quality.

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PB22

The thickness and temperature dependence of ZnO thin films on Si (100) substrate deposited by thermal evaporation

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[keywords] ZnO thin film, thermal evaporation, annealing

Zinc oxide (ZnO) semiconductor materials which have wide band gap of 3.37 eV and high exciton binding energy of 60meV are very important for optoelectronic device applications [1]. Due to these superior optical/electrical properties, many applications such as LEDs, laser diodes and photodetectors are available for ZnO [2]. Several techniques were used to product ZnO thin films, namely, sputtering, spray pyrolysis, sol–gel and evaporation [3]. In this study, ZnO thin films have been prepared by thermal evaporation method. In this technique has many andvantage to others in order to low cost, simple method and also parameters are easily controllable. We have prepared ZnO thin films from ZnO pellets by thermal evaporation with different thicknesses. And then we have annealed the samples different temperatures in air to obtain ZnO films.

In this study, ZnO formation induced by thermal annealing process at 200-400 °C in air for two hours in ZnO/ Si(100) thin film systems are investigated as a function of the initial ZnO film thickness of 150-300 nm using structural and electrical characterization. The effect of thickness and temperature on the growth of ZnO films on Si was systematically characterized by X-ray diffraction (XRD), Scanning Electron Microscopy (SEM), AFM (atomic force microscobe) analysis and classical van der Pauw resistivity measurement. Based on the XRD data, as deposited films are contain only Zn and Si phases. By increasing the temperature, it was found that XRD peaks related to Zn decrease and at 200°C, ZnO peaks starts to appear because of the film oxidation. After 300°C, polycrystalline ZnO phases with higher intensity are formed. SEM and AFM analyses reveals that ZnO nanorods are formed on the surface of all ZnO/Si(100) films. It has been observed that these nanorods on the surface have a random distribution and after annealing from 200°C to 400°C they grow in a columnar way and completely cover the surface. Electrical sheet resistance and resistivity measurements show the transition from conductive Zn thin films to lower conductive ZnO films on Si. At 300 degree, electrical resistivity shows a dramatic increase due to the transformation from Zn rich phases to ZnO phases.

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PB23

Thermal Transport Properties of 2-D Graphene with Carbon Chain

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[keywords] Phonon transport, thermal conductance, thermal transport.

We have examined thermal conductance of graphene by adding CH_3, C_2H, C_3H_3, C_4H, C_5H_3, Benzene, Biphenyl, para-Terphenyl chains on 2-D graphene layer to investigate the effect of these chains on the thermal transport properties. In the relaxation procedures and phonon calculations, DFTB+ software package and PHONOPY used. After obtaining the transmission values of each structure by using Landauer scattering theory of transport, thermal conductance values have been calculated and it shows us the thermal conductance of graphene with carbon chains is less than pristine graphene. We also observed that because of the vibrations of carbon chains, the antiresonance values in transmission and DOS data appears. Here, we propose a method to calculate total conductance value of the system, if we add different kind of carbon chains on the graphene. We made analogy with the electricity by taking 1/T (inverse transmission) values as resistance and calculated the equivalent resistance like serial resistance circuit. We showed that this method has 99% consistent with the thermal conductance values.

PB24

Compressive mechanical properties of nickel nanowires coupling of the pre-oxide shell layer and the size

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We used ReaxFF reactive molecular dynamics simulations to investigate the size effect of the pre-oxide shell layer with size of [001]-oriented nickel (Ni) nanowires (NW) (initial diameters, D= 2.5, 3.25, and 4.0 nm) with the same length ~14.3 nm on the mechanical deformation properties under the uniaxial compressive loading at room temperature. Especially, pristine Ni NWs are considered as references to compare the mechanical properties of the oxide-coated NWs. We found the uniaxial compression properties of pristine Ni NWs are sensitive to both diameter and pre-oxide shell layer thickness. The strength of pristine NW decreases significantly with the decreasing diameter under the applied external compressive uniaxial loading. The native defected pre-oxide shell layer leads to lowering of the mechanical compressive resistivity of NWs under uniaxial compressive loading. Particularly, pre-oxide shell layer less coupled with diameter of NW has pronounced effects essentially on the initiation of initial dislocation to start the plastic deformation and consequently, on the overall plastic response.

PB25

Effect of bias voltage on structure, morphology and hardness of ZrN coating deposited by reactive magnetron sputtering

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[Keywords]: zirconium nitride, sputtering, Bias voltage

ZrN thin films were deposited on silicon (111) and 304 stainless steel substrates using direct current (DC) reactive magnetron sputtering. The effects of the substrate bias voltage on the films' structure, morphology, hardness were investigated. The films were characterized by X-ray diffraction (XRD), field emission scanning electron microscopy (FESEM), atomic force microscopy (AFM) and microhardness tester. XRD patterns showed grain size refinement from 19 to 13 nm with an increase of bias voltage from 0 V to 150 V. In addition, (111) and (200) diffraction peaks were only present and other orientations were omitted. FESEM cross section of ZrN thin films showed a well aligned columnar structure. The increase of bias voltage resulted in hardness rise to about 1720 Vickers at bias voltage of 100 V. Negative bias voltage induce an increase of the films density by the elimination of the porosity and voids. This maximum hardness can be interpreted by a maximum of the film density and minimum of the porosity.

PB26

The Effects of Annealing in Air, Argon and Selenium on Optical Properties of $CuGa_{0.3}In_{0.7}Se_2$ Thin Films

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[keywords] Thin film, CIGS, Photoacoustic spectroscopy, Annealing.

In this work, we present results obtained by annealing CuGa0.3In0.7Se2 (CIGS) thin films absorbers for solar cells applications in various atmospheres (air, Selenium and Argon) using photoacoustic spectroscopy technique [1-2]. Absorbers were deposited on soda-lime glass and Mo/ soda-lime glass substrates by a low cost close-spaced vapor transport (CSVT) technique at various substrate temperatures (440 °C and 500 °C) [3-4]. Solid iodine was used as the transporting agent and it is kept in the lower-temperature region. The schematic drawing of the CSVT system is shown. The zone of reaction consists of a graphite cell placed in a quartz reactor by placing a CIGS graphite source block in close proximity (1mm) to the graphite substrate block. The deposition time was 15 min for all the samples deposited. The resulting films are polycrystalline with a grain size depending on the substrate temperature and iodine pressure in the reactor. Depending on the combination of the growth parameters given above, it was possible to obtain grain sizes between1 and 3 μm and p-type conductivity. The quality of absorbers is analyzed by XRD, SEM, energy dispersive spectroscopy and electrode probe. The changes in the defect states during the annealing processes are investigated using photoacoustic measurements at temperature. Non-radiative transitions were detected, which are associated with shallow and deep levels. Annealing in various atmosphers confirm the mprovement of cristallinity of samples and strong changes in films structure.

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PB27

Aluminum-doped hydrogenated amorphous silicon carbon (a-SiC:H(Al)) by co-pulverization DC magnetron

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[Keywords] Amorphous silicon carbide, DC magnetron sputtering, infrared spectroscopy, Al doping.

In this work, we were interested to the optical, structural and electrical properties of hydrogenated amorphous silicon carbide thin films doped with aluminum (a-SiC:H(Al)). The samples were elaborated by DC magnetron sputtering technique, by using a silicon carbide (6H-SiC) target with plasma generated by a gas mixture of argon and hydrogen. Doping was done in-situ by co-sputtering of aluminum's strands placed symmetrically on the target during the deposition. Various samples were elaborated by modifying the number of strands. We have characterized our samples by optical transmission [1], infrared spectroscopy (FTIR) and electrical measurements (I-T). The results show that the deposition rate decreases greatly with increasing the number of Al strands on the target. The incorporation of Al atoms in the a-SiC:H matrix influences the optical characteristics of the layers by inducing a decrease in the optical gap from 2.3 to 1.7eV [2]. The electrical measurements clearly shows the doping effect where an improvement in the conductivity of the samples doped with aluminum was observed from 10^{-11} to 10^{-7} compared to the conductivity of undoped samples.

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PB28

XPS Analysis of Chemical Vapor Deposition Growth of Graphene from Ethanol

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Recently, Carbon based nanomaterials have provided a new perspective in electronics owing to their very high charge carrier mobility and nanoscale dimensions. In particular, the carbon nanotubes and graphene have been shown to have promising performances suitable for high frequency electronic devices to efficient solar cells, flexible electronic displays to gas sensors, etc. However, the commercial exploitation of graphene is still a challenge because it is critical to synthesize large area graphene with high throughput and reliability. The key to solving this challenge requires us to develop synthesis and transfer methods to employ in the fabrication and transfer of large area single layer graphene films with an optimal degree of control. Considering low cost, scalability and high efficiency, we found chemical vapor deposition (CVD) method to be the most appropriate approach for producing graphene for large-scale manufacture. In this paper, therefore, our aim is to obtain improved and sustainable growth method of large area high-quality graphene. The cleanliness and the quality of the film are checked by x-ray photoelectron spectroscopy. D-parameter (19.5 eV) obtained from carbon Auger feature (C-KVV) and dominated single peak at 284.5 eV assigned to the sp2 graphitic C=C confirms the film deposited on Cu is graphene is clean with no contaminants.

PB29

ITO Coated Touch Sensing Screen

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[keywords] Capacitive touch sensing, ITO, Photomasks, photolithography

Indium Tin Oxide (ITO) is a transparent conducting oxide. ITO coated glasses have resistivity less than $1.3x10^{-4}$ ohm.cm and they transmit light more than 85% in UV visible spectrum [1,2]. In this study, we created a grid pattern by growing ITO on the surface of the screen by using the magnetron sputtering technique. Then the grid-shaped ITO patterns on the screen serve as electrodes at the intersection points of the grid pattern. When you touch on to the screen, your finger forms as a capacitor with an electrode and the ITO coated screen and then it senses & shows the resulting effect where you touch on the screen from the resulting capacitance. In our study, we fabricated ITO thin films on 10 cm x 7 cm soda-lime glass (SLG) with thicknesses of 230 nm. Copper (Cu) photoresist photomasks are used to create the unique patterns on the screen with photolithography technique to obtain the most effective and distinctive sensors. We will test the features of our samples using the MSP-CAPT-FR2633 MSP CapTIvate Driver Card which was bought from Texas Instruments.

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PB30

Fabrication and Characterization of Magnetron sputtered ITO / Au / ITO Thin Film Filters

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[keywords] ITO, magnetron sputtering, filter

Tin doped indium oxide (ITO) thin films are highly degenerated, wide-gap semiconductors with good conductivity and have a high optical transmission across the visible spectrum [1]. ITO films prepared at room temperature by magnetron sputtering, result in a high resistivity material. One way to lower the resistivity is to use ITO/Metal/ITO (IMI) layered thin films [2]. In this study transparent and conducting ITO/Au/ITO multilayered thin films were deposited without substrate heating on polycarbonate (PC) substrate using a magnetron sputtering process at room temperature. We fabricated microwave filters lithographically on 135 nm thin films grown on 5 mm thickness PC substrate. For the simulation studies of transmittance properties of filter structures, CST microwave studio were used. The unique properties of the proposed microwave filter make it suitable for use in optical systems. Their use as frequency selective surfaces is expected to be used for electromagnetic shielding or for filtering purpose by integrating windows of the buildings.

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PB31

Growth of High Quality ITO Thin Films by DC Magnetron Sputtering on Large Area

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[keywords] Indium tin oxide, magnetron sputtering technique

Indium tin oxide (ITO) has been used in the various range of technologies such as plasma display panels,organic light-emitting diodes (OLEDs), liquid crystal displays(LCDs), solar cells, transparent heat reflecting and electrochromic windows due to its unique optical, electrical and structural characteristic [1-2]. Among the transparent conductive oxides (TCO), there is a growing commercial requirement of large area high-quality ITO films on various substrates. The purpose of this study is growing uniform and high-quality ITO thin films on large area substrates. In our previous studies, we had grown ITO thin film on the small area substrates by DC magnetron sputtering [3-4]. In the present study, the growth was done on 30x80 cm^2 surface area glasses on 2, 3 and 4 mm thick by DC magnetron sputtering. in the mixtures of Ar-O_2 atmosphere. During the sputtering process, substrate temperature was kept constant and large area glassses were moved one end to the other by a rotational feedthrough. It is widely known that electrical and optical properties of sputtered ITO films are highly sensitive to deposition conditions so we have optimized the process parameters for large area sputtering. For the structural characterizations and the search the microstructure, SEM and XRD analysis have been carried out. Surface profilometer was used to measure the thickness values of the films and with the help of four point probe procedure the sheet resistance of growth thin films was measured. To measure the sample transmittance, UV spectrophotometer was used in the range of 200 to 2600 nm. Besides the effects of vacuum annealing on structural, electrical and optical features of the large area coated ITO thin films have been investigated. The measured transmittance of large area ITO films was above 85% in the visible spectrum while lowest resistivity of 8.5 Ω/□ was achieved. Reason of this high transmittance is due to the large band gap of ITO which is about 3.70 eV. We are succeded to deposit highly transparent and conductive large area ITO thin films by optimized deposition parameters for various optoelectronic and industrial applications.

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PB32

Increasing the Visible Light Photocatalytic Activity of ZnO_x Layers by Doping with Nitrogen

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[keywords] visible-light photocatalyst, ZnO_xN_y – layer, HiPIMS.

In this paper it is studied the effect of nitrogen doping ZnO_x layers - on their photocatalytic activity. The thin layers of ZnO_xN_y were obtained by reactive high-power impulse magnetron sputtering (HiPIMS) of a pure Zn target in$Ar/N_2/O_2$ gas mixture (with low content of O_2). The variation of the discharge pulsing frequency has led to depositions of crystalline ZnO_xN_y thin films with the different nitrogen content. The thin layers obtained were investigated by XPS, SEM, AFM analysis, X-ray diffraction and UV-Vis spectroscopy. Photocatalytic activity was assessed by degradation of the methylene blue solution (MB) under irradiation with visible light. Experimental results indicate that, by doping the ZnO_x layer with nitrogen, both visible-light absorption rate and photocatalytic activity increase due to optical band gap narrowing. Beside optical band gap, the photocatalytic activity of nitrogen–doped ZnO_x thin films strongly depends on the crystalline order.

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PB33

ZTO/Ag/ZTO Thin Films Fabricated on PET Substrates for Large Area Flexible OLEDs

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[keywords] OLED, Flexible Substrate, ZTO, Magnetron Sputtering.

Usage of flexible organic light-emitting diodes (OLEDs) in curved displays smartphones and televisions show a significant growth in more commercial applications [1]. Recently, remarkable progress has been observed in producing flexible electronics, so that flexible OLEDs open up a wide ranging of possibilities for applications in lightweight, portable, wearable and even deformable displays, sensors, as well as solid-state lighting [1]. The advantages of OLED in comparison with the existing liquid crystal display (LCD) technology, are self-emission, wide viewing angle, fast response time, simple structure, and low driving voltage [2]. For efficiency and uniform light emission in OLEDs, highly conductive and transparent anodes are required. Indium oxide doped with tin (ITO) due to its unique electrical and optical properties such as good conductivity (about 10^4 Ω^{-1} cm^{-1}) and high transmittance (~85%) in the visible region owing to the large bandgap of about 3.70 eV has been most promising anodes among the transparent conductive oxides (TCO) thin film [3]. Aluminum-doped zinc oxide (AZO) is another TCO which is widely used for many applications on literature [4]. However, due to the scarcity of indium, alternative anodes that eliminate its use are highly desired [5]. For this reason, in this research Zn-Sn-O (ZTO) has been used as a replacement of ITO and its suitable candidacy as an anode in OLED production has been investigated. The advantages of optimized ZTO thin film in comparison to ITO are abundancy on the earth, better performance, low sheet resistance, less surface roughness, and the capability to be produced as large area thin film for the flexible OLED. ZTO/Ag/ZTO thin film layers has been coated on flexible Polyethylene terephthalate (PET) substrates with the range of 75-125 μm thickness by magnetron sputtering. The crystal structure of the electrodes has been analyzed by X-ray Crystallography (XRD) and the relation between the flexibility and the resistance of the substrate has been determined. The morphology and interface layer between the ZTO and Ag, has been investigated by Scanning Electron Microscopy (SEM). Using four probe method in room temperature the resistance and sheet resistance of ZTO/Ag/ZTO coated electrodes on flexible PET has been determined. The optical transmittance of the electrodes has been measured by UV/visible region spectrometer. The surface roughness of the electrodes has been investigated by Atomic Force Microscope (AFM).

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PB34

Thermal numerical analysis of crucible induction heating in a crystal pulling (CZ) furnace

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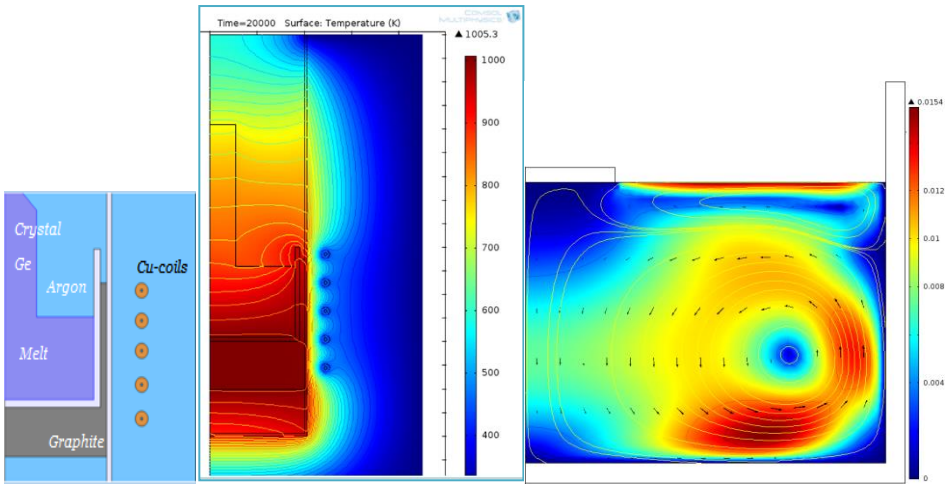
Numerical modeling is conducted to study the induction heating of a crucible for crystal growth. The aim is to accurately determine the thermal field in the central region, to give some important information for better interpretation of the process. All types of heat transfer are considered. The knowledge of temperature distribution to predict thermal losses (gradients) in all parts of the furnace are important to overcome. Numerical simulation taking into account all physical phenomena is a powerful tool, may be more precise, but needs long calculations. Many studies have already been reported on modeling of transport processes in crystal growth considering the different involved phenomena (induction heating, convection and radiation, phase change) in a global simulation model [1[3]. We first give a description of the considered experimental furnace, and then we present the mathematical model used to perform the numerical simulation, and discuss the main results obtained in the case of InI (indium iodide) semiconductor.



Schemas of Crystal growth system; Thermal distribution in the furnace; Melt flow convection

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PB35

Structural and Magnetic Properties of $(Ni_{80}Fe_{20})_x/Cu_{(1-x)}$ Alloy Thin Films

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[Keywords]: Ferromagnetic resonance, NiFe/Cu alloys, Magnetic Anisotropy

For better understanding of magnetic properties of magnetic thin films, it is necessary to know both magnetic behavior and crystalline structure together. And also the structural and magnetic properties of magnetic thin films depend on the parameters of substrate temperature, growth technique, chemical composition, interface effects and so on. They affect properties such as magnetic saturation (M_s), mangnetic anisotropy (K_{eff}) and coercive field (C_h). Producing new magnetic thin films and stacks systems is necessary for novel spin based device applications. In this study, as far as our best knowledge, we prepared and investigated single crystalline $(NiFe)_xCu_{(1-x)}$ thin films.

$(NiFe)_xCu_{(1-x)}$ single crystalline alloy thin films were prepared on MgO (100) substrate in sputter chamber with a 10^{-9} mbar base pressure. Structural and magnetic properties of the alloy films investigated by varying chemical composition. The crystal structure of alloy films were determined by using X-Ray diffractometer (XRD). It was observed that the lattice constants changed with the composition. The magnetic properties were defined by measuring FMR (Ferromagnetic Resonance) technique at room temperature. Two FMR picks observed which refers to two different magnetical ordered pleases in the thin films. Analysis of FMR spectra showed that there is a strong uniaxial anisotropy in the film plane. We conclude that the structural and magnetic properties of $NiFe_xCu_{(1-x)}$ alloy thin films are strongly correlated.

PB36

Hydrothermal-Electrochemical Deposition of Semiconductor Thin Films for Solar Energy Harvesting

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[keywords] Hydrothermal, electrodeposition, Photoelectrochemical Cells

In this study, we explored hydrothermal-electrodeposition (HED) as a means of developing semiconductor metal oxide photoelectrodes for electricity and hydrogen production using solar energy. HED allows electrodeposition at temperatures higher than 100 ◦C which is the limit for aqueous reactions at ambient conditions. High bath temperature primarily affects the growth kinetics; and thereby, crystallinity and morphology of deposited particles. Since morphological details of a semiconductor electrode such as size, shape, and connectivity of the particles often dictate physical properties, understanding and controlling the morphological aspects of polycrystalline electrodes is critical in producing highly efficient devices. We have shown that by the synergistic effect of the growth-modifier molecules and HED, metal oxide particles with various shapes including worm like, spherical, rhombohedral, square planar particles, and platelets can be obtained Effect of additives is significantly influenced by high temperature electrodeposition with each cation and anion behaving differently. Through HED, we obtained 1-D ZnO nanorods regardless of precursor concentration although similar reactions at 90 C yields platelets or rods depending on the concentration [1]. HED allows control over rod diameter by adjustment of [$MnCl_2$] in deposition bath, [2]. We also obtained hierarchical ZnO architectures at a single-step through HED only by modifying [$Cd(CH3COO)_2$/Zn(II)] [3]. Moreover, we have grown heterogeneous ZnO-Co nanostructures with Co rich spheres on a zinc rich matrix, where the degree of phase separation and the quantity of the initial Co rich spheres are determined by Co(II) concentration [4]. It is discovered that HED enables production of crystalline α-Fe_2O_3 phase without thermal annealing requirement as opposed to electrodepositions reported at ambient temperature [5]. Photoelectrochemical studies demonstrated that higher performance can be obtained with the films prepared via HED for solar H_2 production. Moreover, α-Fe_2O_3 with different morphologies, including worm like, spherical, rhombohedral, square planar particles, and platelets, were obtained when HED is used together with growth-modifying species such as $CH3COO^-$, Ce^{3+} and F^- [6], [7].

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PB37

Synthesis of $Cu_2ZnSnSe_4$ Bulk Crystal for Solar Cells Application

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[keywords] solar cells, CZTSe, EDS, XRD, Hall Effect.

Recently, $Cu_2ZnSn(S,Se)_4$ quaternary compounds have drawn more attention as being a promising candidate for the absorber layer in solar cells because of their non toxicity and abandonment in addition to their photovoltaic proprieties [1-3]. The main purpose of this work is to synthesis the CZTSe alloy by a simple melt growth technique. For this, the Cu (6N), Zn (4N), Sn (5N) and Se (2N) elements were charged with stoichiometric proportions into a 200 mm length and 14 mm diameter quartz tube sealed off under $5x10^{-6}$ torr, then placed in a horizontal furnace and heated up gradually. The tube was kept at 300 °C for 8 h to ensure the formation of secondary phases between Cu, Zn and Sn with Se to decrease the vapor pressure in the tube to avoid any explosion in high temperature. To ensure homogeneous mixing of the melt, the tube was kept at 1100 °C for 24 h, the furnace was then cooled down reaching room temperature. The ingot chemical composition analyses determined by Energy Dispersive Spectroscopy (EDS) were found to be nearly stoichiometric. The powder X-ray diffraction (XRD) pattern of the CZTSe bulk crystal showed preferred orientations of (112), (220) and (312) planes, confirming the Kesterite structure. Lattice parameters of a=5.687 Å, c=11.35 Å are found. Crystal electrical proprieties are estimated using Hall Effect measurements at room temperature. The carrier concentration p, hole mobility μ_h and conductivity σ are measured to be=~10^{15}-10^{16} cm^3, 4 - 200 cm^2/V s and 0.1-1.75 Ω^{-1} cm^{-1}, respectively.

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PB38

ITO Large Scale Thin Film Deposition on Flexible PET Substrates For Solar Cell Applications

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[keywords] Photovoltaics, ITO thin films, large area coatings.

Transparent conducting oxides (TCOs) have attracted much attention in recent years with respect to their unique and hugely useful properties. Among the commercially available TCOs, Indium tin oxide (ITO) has a special place with a wide bandgap, relatively high work function (WF) and it is usually preferred for solar cells as an electrode layer [1-3]. Optoelectronic device applications, especially photovoltaics requiring flexible substrates with excellent conductivity and high transparency and ITO coated flexible transparent electrode materials are the suitable candidates. On the other hand, there are a few problems about ITO deposition on flexible substrates as durability, the poor adhesion and low crystalline qualities. In this study, roll-to-roll DC magnetron sputtering system was used to deposite large area ITO on polyethylene terephthalate (PET) substrates. We have preferred 25 and 75 μm thick PET substrates with a size of 40 cm x 150 m which were fold up to the vacuum chamber and rolled one end to the other by a rotational feedthrough. ITO films were deposited with different parameters and rolling speed for each ten meters of flexible substrate. By the help of optical emission spectroscopy (OES) analysis, the effect of growth conditions on the film properties have been investigated intensively. AFM analysis have been carried out to observe the quality of microstructures and surface roughness to improve transmission and conductivity. The transmission characteristics were measured by a UV Spectrophotometer. Our aim was to optimize the sputtering conditions and control the OES results to have very uniform large area ITO films on PET substrates with high transparency (>85%) and low electrical resistivity (R_s<50 ohm/sqr). In addition tı these, the enhancement of adhesion between a PET-ITO layers has comprehensively investigated to improve the WF.

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PB39

Layer-by-Layer System for 2D Materials

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[keywords] nanofilm, 2D materials, automated dipping system, layer-by-layer method

Inorganic nanosheets, member of the two-dimensional (2D) materials family, have thickness around few nanometers and lateral size of several micrometers. Inorganic nanosheets, obtained by soft-chemical exfoliation of bulk layered oxide materials, disperse in colloidal solution. Thus, nanofilms composed of nanosheets can be produced by solution-based synthetic techniques which are layer-by-layer [1] and flocculation methods [2]. The layer-by-layer method, i.e. electrostatic sequential adsorption method, is a very effective technique to produce composite nanofilms [3]. The quality of the nanofilms depends on the lateral size and the electrostatic charge of the nanosheets. So, if a new type of nanofilm is produced, the parameters of experimental technique should be swept to maximize the film quality. Therefore, in this study, the performance of nanofilm production was tested by a layer-by-layer system. The system facilitates the production of nanofilms with coating and drying units effectively.

In this study, layered inorganic material was protonated and exfoliated to yield inorganic 2D materials. The 2D materials were coated on quartz substrates using the layer-by-layer system for multilayer nanofilm deposition. Atomic Force Microscopy and UV-visible spectrophotometer were used for characterization of the nanofilms. The results suggest that the layer-by-layer system is an effective system offering the production of more controlled multilayer nanofilms by optimizing the experimental parameters.

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PB40

Transparent conducting films of Nb and F codoped tin oxide

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[keywords] Thin films, solar energy.

It is well known that most oxides are insulators in amorphous or crystalline forms, particularly combinations between oxygen and silicon. However, some oxides exhibit metallic conduction; for example, vanadium oxide ($M_xV_2O_5$) and tungsten oxide (M_xWO_3) have a metal insulator transition at certain carrier concentration [1]. Other kinds of oxides with high conductivity are heavily doped n-type semiconductors such as In_2O_3:Sn and SnO_2:F known as ITO and FTO, respectively. Materials exhibiting simultaneously both high conductivity and optical transmittance are named transparent conductors; thin films of ITO and FTO fulfill these requirements; these materials are known as transparent conductor oxides (TCOs). Investigations about TCOs are very comprehensive due to their great variety of applications [2]. However, different alternatives have been developed including carbon based hybrid materials. Hybrid materials based on Cu-nanowires/graphene oxide and An-grids/graphene oxide have exhibited sheet resistance (Rs) values as low as 18-28 □/sq and T around 80-90%. On the other hand, the metal oxide based alternatives have been focused on doped oxides such as W:SnO_2, Sb:SnO_2, Nb:SnO_2, Nb:TiO_2, and W:TiO_2. Among them, the Nb-doped tin oxide (NTO) films have been the focus of both theoretical and experimental research, which report the NTO films as potential TCOs. Here the combined effects of dopants such as fluorine and niobium are studied in detail. For this, different characterization techniques have been used such as X-ray diffraction (XRD), Raman spectroscopy, atomic force microscopy (AFM), four point probe resistivity measurements, optical transmission, and XPS were used. Additionally, *ab-initio* calculations were employed in this study.

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PB41

Plasma Characteristics Aiding the Enhancement of Surface-Modified-Polyethylene

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[keywords] Surface modification, RF plasma discharge, electron temperature, Boltzmann plot, polyethylene.

Although several plasma techniques such as microwave, dielectric barrier, or radio frequency plasma discharges are used to enhance the surface properties of polymers with low surface energies, characteristics of the plasma discharge are not investigated thoroughly during such processes [1]. In this study, we mainly focus on the correlation between the change of plasma characteristics and the enhancement of the surface processed. A capacitively coupled radio frequency (RF) plasma discharge is used to enhance the surface properties of polyethylene. RF plasma discharges are known to modify the polymer surface chemistry without changing its bulk property [2]. The RF input power is scanned in a wide range of 50 W – 500 W while other plasma parameters such as gas flow rate, exposure time, and gas pressure are kept constant. The plasma discharge is generated with a 13.56 MHz RF generator using Argon gas inside a chamber consisting of two parallel electrodes. Plasma properties are investigated during the process using a broadband optical emission spectrometer and the electron temperature is calculated using the Boltzmann plot method. The electron temperature increases as the RF input power increases. It can be considered that plasma species such as electrons, ions, and free radicals give the necessary energy to the surface. After this energy transfer, the surface energy of the polymer is significantly improved. New functional groups having high crosslinking and branched structures are formed on the surface. The change of surface chemistry is characterized using a X-ray photoelectron and a Fourier transform infrared-attenuated total reflection spectrometer. Moreover, improvement of the surface crystallization is investigated is measured using an X-Ray diffraction spectrometer. Presence of new functional groups significantly improves the morphology of the polymers, which is evaluated using a scanning electron microscope. The wettability is characterized measuring the water contact angle and results show that hydrophobic surface of polyethylene in nature indicates high hydrophilic characteristic after the plasma exposure. Therefore, it can be considered that more adhesive polyethylene surfaces are obtained after the plasma surface modification process.

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Synthesis and Characterization of TiO_2 Coatings Achieved by a High Power Atmospheric Pressure Axial Injection Plasma Torch

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[keywords] TiO_2 coating, microwave plasma torch, atmospheric pressure deposition, XRD analysis.

Axial Injection Torch (AIT) is a device designed to utilize microwave power to produce dense plasmas. In this study, we aim to deposit metal oxide layer, namely Titania, TiO_2, onto silicone substrates using an AIT system. Titania is a material that can be used in a wide range of applications including solar panels coatings [1]. As oppose to common methods such as CVD and PVD, which may involve environmental issues due to the chemicals used (in CVD) and step coverage problems (in PVD), the plasma deposition using AIT can be achieved using an inert gas at atmospheric pressure. The experiments are conducted using Argon plasma generated by AIT at atmospheric pressures to deposit TiO_2 on the substrate. Deposition is studied by varying the deposition duration, the microwave power and the Argon gas flow rate. The deposited samples are analyzed using an X-Ray Diffraction Spectroscopy method, which is a technique to understand the molecular and physical structure of crystals. The spectral peaks referring to the phases of the TiO_2 are investigated. At first, the effect of the deposition duration is studied at constant microwave power and gas flow rate. It is found that arrangement of the rutile structures is improved in crystallinity of deposited TiO_2 while no significant changes are observed in arrangement of the anatase structures. Secondly, the effect of increased microwave power is studied while the other parameters are kept constant. It is observed that the crystallinity of deposited TiO_2 decreases with an increasing power. Finally, the process is reiterated once more at various gas flow rates. As a result, it is found that the ion bombardment plays an important role in determining the characteristics of coated TiO_2 due to changing the concentration of fragmentation and recombination during the deposition process. In addition to these XRD results, an attenuated total reflection (ATR) spectroscopy is used to measure the chemical structures of the coated TiO_2 material. Results show that TiO_2 material can be effectively deposited on silicon substrates at atmospheric pressure using the AIT plasma system.

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Photocatalytic degradation of azo dye using silicon nanowires modified by grapheme-copper nanocomposite as photocatocatalyst

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[Keywords]: Silicon nanowires (SiNWs), Graphene oxide, Copper nanoparticles, Photocatalysis, UV-VIS spectroscopy.

The application of semiconductors in heterogeneous photocatalysis to eliminate various pollutants in aqueous systems as well as in the air has gained significant attention in the last decade. In the present work, we report on the high efficiency of graphene oxide decorated with copper nanoparticles for the degradation of azo dye like Tartrazine and Rhodamine (B) under Visible light irradiation. Also, the effect of voltage on the graphene oxide-copper nanocomposite deposit on the silicon nanowires by electrophoretic method was study. Tartrazine and Rhodamine B used as model organic dye; they used lot of in the textile industry [1, 2]. Dyes are an important factor in environmental pollution and its degradation mechanism has been studied quite well.

The absorption spectra of the tartrazine and Rhodamine B solutions in quartz cuvettes with an optical path of 10 mm were recorded using a CARY 500 "VARIAN" UV–vis spectrophotometer. The wavelength ranges were 200–600 nm for tartrazine and 400-700 for rhodamine B. The results show a significant efficiency of graphene oxide-copper nanocomposite for the degradation of these organic pollutants.

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Investigating Magnetic Properties of FM/NM Multilayer Thin Films

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Keywords: Magnetic multilayers, Magnetic anisotropy, Exchange coupling

Magnetic multilayer structures of FM/NM/FM, where two ferromagnetic (FM) layers are separated by a nonmagnetic (NM) spacer layer, have attracted great research interest due to due to their technological applications in magnetic sensors based on magnetic tunnel junctions or spin valves structures[1]. These systems exhibit rich physics including spin-dependent scattering, interlayer exchange coupling, spin-torque effects[2].In particular, attention has been focused on place in the interlayer exchange coupling (IEC) of ferromagnetic heterostructures with in-plane anisotropy. On the other hand, it has become necessary to work on magnetic thin film with perpendicular magnetic anisotropy (PMA) in order to achieve the goals of increasing field density in the magnetic memory. We fabricated FM/NM bilayers on Si (100) by magnetron sputtering with out-of-plane. We investigated the magnetic properties of our multilayers by ferromagnetic resonance (FMR) measurements, depending on the thickness of the spacer NM layer. In this study, we observe that critical NM thickness can be change the exchange coupling. This is potentially interesting for and new spintronic applications[3].

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