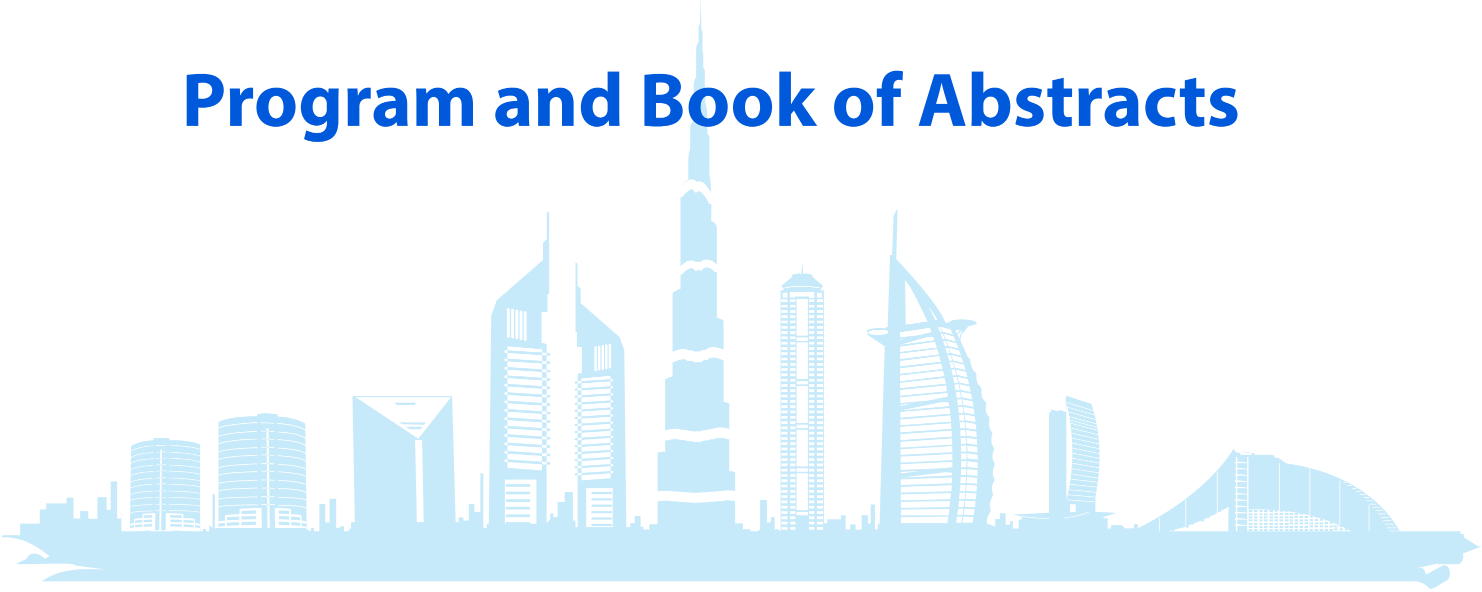
Nanotech / Biotech / Surtech
Middle East 2017

Conference and Exhibition
4 - 6 December, 2017

Dubai International Convention and Exhibition Centre
Dubai - UAE

Program and Book of Abstracts



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Nanotech ME 2017 / Surtech ME 2017 / Biotech ME 2017 Conference Program

December 4 - 6, 2017 | Dubai, U.A.E

December 4, 2017
Nanotech ME 2017 Session I: Nanomaterials Fabrication, Characterization and Properties

Conference Room - Sheikh Maktoum Hall

Session Chairs:
Prof Daniel Choi, Masdar Institute, UAE
Prof. Rashid K. Abu Al-Rub, Masdar Institute - Abu Dhabi, UAE

08:00 - 10:00 Registration + Welcoming Coffee

10:00-10:30	Near term commercial applications for Graphene, Composites and Conductive Pastes **R. Gibbs**	**Mr. Ray Gibbs**, Haydale Graphene Industries Plc, **UK**
10:30-11:00	Novel Types of Multifunctional Micro/Nano-Architected Materials **R.K. Abu Al-Rub**	**Prof. Rashid K. Abu Al-Rub**, Masdar Institute – Abu Dhabi, **UAE**
11:00-11:30	Challenges on modeling of grain size impact on polycrystalline metallic behavior **A. Abdul-Latif**, S. Ramtani and N. A. Zontsika	**Prof. Akrum Abdul-Latif,** Paris 8 University**, France**
11:30- 12:00	Application of bioleaching solutions for the biosynthesis of metal nanoparticles **Z. Sadowski** and A. Pawlowska	**Prof. Zygmunt Sadowski**, Wroclaw University of Science and Technology, **Poland**

12:00 - 14:00 Lunch Break / Posters Session I

Session Chairs:
Prof. Rashid K. Abu Al-Rub, Masdar Institute, Abu Dhabi, UAE
Prof. Akrum Abdul-Latif, Paris 8 University, France
Prof. Zygmunt Sadowski, Wroclaw University of Science and Technology, Poland

14:00-14:30	Graphene-2D Materials Nanoelectromechanical (NEM) Devices and Its Extreme Sensitivity **M. Muruganthan**, H. Van Ngoc, J. Kulothungan, M.E. Schmidt and H. Mizuta	**Dr. Manoharan Muruganthan**, Japan Advanced Institute of Science and Tehcnology, **Japan**
14:30-15:00	Effect of Secondary Phases on Deformation Nanostructuring and Strengthening of Aluminum Alloys **M. Markushev**, S. Krymskiy, E. Avtokratova and O. Sitdikov	**Prof. Michael Markushev**, Institute for Metals Super plasticity Problems, **Russia**
15:00-15:15	Continuous-Flow Assisted Method for Scaling up Nanoparticles Synthesis **L. Sinatra**, M. Lutfullin, J. Pan and O. Bakr	**Dr. Lutfan Sinatra**, Quantum Solutions LLC**, Saudi Arabia**
15:15-15:30	Understanding the technology behind world's highest resolution micro 3D printer and its applications **R. Ahmad**	**Mr. Rameez Ahmad**, Nanoscribe GmbH, **Germany**
15:30-16:00	Optical characterization and related applications of cerium oxide nanoparticles **N.Shehata**	**Dr. Nader Shehata**, Alexandria University, **Egypt**

16:00 - 16:30 Coffee Break / Posters Session I

16:30-17:00	Structural and dynamical study of semicrystalline block copolymers J. Jenczyk and **S. Jurga**	**Prof. Stefan Jurga**, Adam Mickiewicz University, **Poland**
17:00-17:15	Controlled Synthesis of different ZnO Nanostructures for Sensing Applications **M. Alenezi**	**Dr. Mohammad Alenezi**, PAAET, **Kuwait**
17:15-17:30	Influence of thermal processing rate on the structural and morphological properties of Cu2SnS3(CTS) prepared using solid state reaction technique N. J Choudhari, N. Shubhava and **Y. Raviprakash**	**Dr. Raviprakash Y**, Manipal University, **India**
17:30-17:45	Synthesis of ZnO nanowires with supercritical carbon dioxide and post heat treatment **A. Kaleva**, J-P. Nikkanen, S. Heinonen, V. Saarimaa, T. Vuorinen and E. Levänen	**Mr. Aaretti Kaleva**, Tampere University of Technology, **Finland**

17:45-18:00	Effects of Electron Beam Irradiation on Al/n-Si Schottky Diode Parameters **P.Kumara Shetty**, I.Panduranga Vali and M.G. Mahesha	**Dr. Pramoda Kumara Shetty**, Manipal University, **India**
18:00-18:15	The Study of Physical Properties of Fractal Graphene Layers **N. Margaryan**	**Mr. Narek Margaryan**, National Polytechnic University of Armenia, **Armenia**
18:15-18:30	Dynamic Mechanical properties of Oil Palm Nano filler based epoxy Nanocomposites N.Saba, **M. Jawaid**, O. Y Alothman and P.Md Tahir	**Dr. Mohammad Jawaid**, Putra University Malaysia, **Malaysia**

Conference Room Dubai D (First floor)

Joint Session I.A - Surtech ME 2017 / Nanotech ME 2017 / Biotech ME 2017

Session Chair:

Dr. Manoharan Muruganthan, Japan Advanced Institute of Science and Tehcnology

16:30-17:00	Developpement of “bio” Titanium based thin films **A. Alhussein**, S. Achache and F. Sanchette	**Prof. Akram Alhussein**, University of Technology of Troyes, **France**
17:00-17:15	The research of Pt ALD on various textiles materials and understanding of fundamentals behind the surface reactions between Pt and textiles **J.S. Park**, I-K. Oh, T-H. Han, R. Khan, H. Kim, and H.B.R. Lee	**Mr Jong Seo Park**, Yonsei University, **Rep. of Korea**
17:15-17:30	Wear Properties of Detonation Gun deposited Steel Reinforced with Tungsten Carbide particulates I. Shakhova, **F. Azarmi** and X.W. Tangpong	**Prof. Fardad Azarmi,** North Dakota State University, **USA**
17:30-17:45	Bacteria-Responsive Gold Nanoclusters-Mesoporous Silica-Polymer Mixed Membrane Coating: Simultaneous Detection and Inhibition of Healthcare-Associated Infections **S.K. Alsaiari**, M.A. Hammami, J. G. Croissant, H.W. Omar,† P. Neelakanda, T. Yapici, K-V. Peinemann and N.M. Khashab	**Ms. Shahad K. Alsaiari**, King Abdullah University of Science and Technology (KAUST), **Saudi Arabia**
17:45-18:00	A study of wear performance and Lubrication mechanism of WC-10Co-4Cr HVOF sprayed coating under engine oil and graphitic nanoplatelets **Y.Sidra** and A.Mateen	**Mrs. Sidrah Younuskhan**, Institute of Space Technology, Islamabad, **Pakistan**
18:00-18:15	Laser Inscription of Pseudorandom Structures for Microphotonic Diffuser Applications **T. Alqurashi** and H. Butt	**Mr. Tawfiq AlQurashi**, University of Birmingham **United Kingdom**
18:15-18:30	Fe Nanoparticles in CuAl Alloy Matrix Systems **M.S.Kurt**, S. Baker and M; Richard Lees	**Dr. Mustafa Sukru Kurt**, Erzurum Technical University, **Turkey**

December 5, 2017

Nanotech ME 2017 / Surtech ME 2017 Session II: Nanomaterials for Energy and Environment / Nano Electronics

Conference Room - Sheikh Maktoum Hall

Session Chairs:
Prof Daniel Choi, Masdar Institute, UAE
Prof. Haris Doumanidis, Khalifa University, UAE
Mr. Joe Davis, Vice President, Sales Engineer, Tesla NanoCoatings, USA

09:00-09:30	Underwater Robotic Manufacturing by Biomimetic Macroscale Assembly A. Alzaabi, A. Hussien, F. Renda, C. Stefanini and **C. Doumanidis**	**Prof. Haris Doumanidis**, Khalifa University, **United Arab Emirates**
09:30-10:00	One-dimensional nanoworld for energy applications **D. Choi**	**Prof Daniel Choi**, Masdar Institute, **UAE**
10:00-10:30	Nanoscale Carbon Solutions for Harsh Marine and Offshore Environments	**Mr. Joe Davis**, Tesla NanoCoatings, **USA**
10:30 - 11:00 Coffee Break / Posters Session II		
11:00-11:30	Expansion of Institute Coatings Programs to Support Asset Management of Coatings Systems	**Mr Gasem Fallatah**, NACE Int. West Asia & Africa Area, **KSA**
11:30-12:00	Graphene for energy and environment applications **M. Kemp**	**Dr. Martin Kemp**, XCIENCE Ltd, **UK**
12:00-12:30	Towards a discovery solution for nanotechnology - Challenges & Prospects **A. Gheisi**, P. Roy, J. Xiao and W. Chiuman	**Dr. Amir Gheisi**, Springer Nature, **Germany**
12:30 - 13:45 Lunch Break / Posters Session II		
13:45-14:00 Conference Group Photo		

Nanotech ME 2017 Session II.A: Nanomaterials for Energy and Environment

Conference Room - Sheikh Maktoum Hall

Session Chairs:
Prof Daniel Choi, Masdar Institute, UAE
Dr. Muataz Ali Atieh, Qatar Environment and Energy Research Institute, Qatar
Dr. Martin Kemp, XCIENCE Ltd, UK

14:00-14:45	Towards Mechanistic Understanding of the Role of Nanoparticle Technology in Energy and the Environment Applications **N. Nassar**	**Prof. Nashaat N. Nassar**, University of Calgary, **Canada**
14:45-15:15	Carbon Nanomaterials for Water Treatment Applications **M.A. Hussien**	**Dr. Muataz Ali Atieh,** Qatar Environment and Energy Research Institute, **Qatar**
15:15-15:45	Pulsed Lasers based writing of Reconfigurable Nanopatterns **H. Butt**	**Dr. Haider Butt**, University of Birmingham, **UK**
16:00 - 16:30 Coffee Break / Posters Session I		
16:30-17:00	Hydrothermal synthesis of manganese phosphate/graphene foam composite for electrochemical supercapacitor applications A.A. Moshawe and **N. Manyala**	**Prof. Ncholu Manyala**, University of Pretoria, **S. Africa**
17:00-17:15	Progress in Nanocrystal Zeolites of MFI for Hydrocarbon Cracking **E.N. Al-Shafei**, O. Muraza, M.A. Sanhoob, A.K. Jamil , K-H. Choi, M.A. Abdullah and A.S. Alnaser	**Dr. Emad N. Al-Shafei,** Research and Development Center, Saudi Aramco, **K.S.A**
17:15-17:30	Microwave-assisted synthesis of cobalt sulphide nanoparticles clusters on activated graphene foam for electrochemical supercapacitor **T.M. Masikhwa** and N. Manyala	**Dr. Tshifhiwa M. Masikhwa**, University of Pretoria, **S. Africa**
17:30-17:45	Nanotechnology of Pinning Centres in Superconducting Films for Clean Energy-saving Power Applications **A. Crisan**, I. Ivan and L. Miu	**Dr. Adrian Crisan**, National Institute for Materials Physics Bucharest, **Romania**

17:45-18:00	Novel rGO/CdS encapsulated SNC for improved Oxygen Reduction reaction **S. Chandrasekaran**, L.Wang, L.Sui, T.Ngo, J.S.Chung and S. H. Hur	**Dr. Sundaram Chandrasekaran**, University of Ulsan, **Rep. of Korea**
18:00-18:15	Sustainable Valorization of Carbon Dioxide towards Methane with Ionic Liquids Nanoparticles **E. Bogel-Łukasik**, C.I. Melo, L.C. Branco and M.Nunes da Ponte	**Dr. Ewa Bogel-Łukasik**, NOVA University of Lisbon, **Portugal**
16:00 - 16:30 Coffee Break / Posters Session II		

Nanotech ME 2017, Session II.B: Nanoelectronics

Conference Room Dubai D (First floor)

Session Chairs: Prof. Ncholu Manyala, University of Pretoria, S. Africa
Prof. Alexander Gorokhovsky, Yuri Gagarin State Technical University of Saratov, Russia
Prof. Elhadj Dogheche, University of Valenciennes, France

14:00-14:30	Design, Fabrication and Characterization of III-nitride high speed photonic sensors B. Alshehri, K. Dogheche, S. Belahsene, A. Ramdane and **E. Dogheche**	**Prof. Elhadj Dogheche**, University of Valenciennes, **France**.
14:30-15:00	Design and Properties of Heterostructured Nanoparticles based on modified potassium polytitanates **A. Gorokhovsky**, V. Goffman, E. Tretyachenko, N. Gorshkov, M. Vikulova, D. Kovaleva,	**Prof. Alexander Gorokhovsky**, Yuri Gagarin State Technical University of Saratov, **Russia**
15:00-15:30	Flexible Superhydrophobic Electrochromic Devices S.K. Nemani,M.M. Jamal Hazem, D. Chen and **H.Sojoudi**	**Prof. Hossein Sojoudi**, University of Toledo, **USA**
15:30-15:45	Novel Light Emitting Materials Based on Low Dimensional Perovskites **M. Lutfullin**, L. Sinatra, J. Pan and O. Bakr	**Dr. Marat Lutfullin**, Quantum Solutions LLC, Thuwal, **Saudi Arabia**
15:45-16:00	Effects of pressure and magnetic field on a two-dimensional Heisenberg antiferromagnet.	**Mr. Nicolò Barbero**, ETH Zurich, **Switzerland**
16:00 - 16:30 Coffee Break / Posters Session II		
16:30-16:45	High aspect ratio micro and nanostructures enabled by photo-electrochemical etching for sensing and energy harvesting applications. **B. Alhalaili**, D. Dryden, M. Ombaba, H. Cansizoglu, Y. Gao and M. Saif Islam	**Ms. Badriyah Alhalaili**, University of California, Davis, **USA**
16:45-17:00	Growth and Characterization of a Nonlinear Optical Organic Crystal: 2,4,5-Trichloroacetanilide **V. Upadhyaya**	**Dr. Vyasa Upadhyaya**, Manipal University, **India**
17:00-17:15	A hidden correlation between absorption spectra of graphene nanoribbons and carbon nanotubes **V. A. Saroka**, M. V. Shuba and M. E. Portnoi	**Dr. Vasil Saroka**, Belarusian State University, **Belarus**
17:15-17:30	Photoelectrochemical study of Antimony doped SnO2 film/ Chromate solution **R. Outemzabet**, H. Ali, M. Trari, R. Brahimi and B. Bellal	**Prof. Outemzabet Ratiba**, University of Sciences and Technology Houari Boumediene, **Algeria**
17:30-17:45	PVB encapsulant polymer functionalized with luminescent down-shifting technique as emerging material **K. Agroui**, G. Collins, G.Oreski, O.Arfi and N.Drouiche	**Dr. Kamel Agroui**, Semiconductors Technology for Energetic Research Center, **Algeria**

December 6, 2017
Session III. A, Joint Nanotech ME 2017 / Biotech ME 2017

Conference Room - Sheikh Maktoum Hall		
Session Chairs: Prof. Stefan Jurga, Adam Mickiewicz University, Poland Dr. Haider Butt, University of Birmingham, UK		
09:00-09:30	Passion fruit-like nano-architectures: generalized production and bio-applications D. Cassano,S. Pocovi-Martinez and **V. Voliani**	**Dr.Valerio Voliani**, Istituto Italiano di Tecnologia, **Italy**
09:30-09:45	Optical biosensors detection of mycotoxins using aptamer-based gold nanostructures **A. Al Rubaye**, A. Nabok, G. Catanante, J-L. Marty, E. Takacs and A. Szekacs	**Mr. Ali Al Rubaye**, Sheffield Hallam University, **United Kingdom**
09:45-10:00	Mycotoxin biosensor based on optical planar waveguide **A.M. Al-Jawdah**, A. Nabok, A. Holloway and A. Tsargorodska	**Mr. Ali M. Al-Jawdah**, Sheffield Hallam University, **United Kingdom**
10:00 - 10:30 Coffee Break / Posters Session II		
10:30-11:00	Nature Inspired Optical Biosensors **H. Butt**	**Dr. Haider Butt**, University of Birmingham, **UK**
11:00-11:15	Improved Anticancer Activity of siRNA/Calcium Phosphate Nanoparticle Systems in Lung Cancer Cells **G. Kara**, F. Bakan, A. Parlar, T. Sutlu and E.B. Denkbas	**Ms. Goknur Kara**, Hacettepe University, **Turkey**
11:15-11:30	Core fucosylation of Asn297 glycosylation site effects on IgG2-based therapeutic monoclonal antibodies biological and biophysical properties and fucosylation kinetics **K. K. Al-Kinani**, D.R. White, C. R.Middaugh and T.J. Tolbert	**Dr. Khalid K. Al-Kinani**, University of Baghdad, **Iraq**
11:30-11:45	Aflatoxin M1 Decontamination Potential of Free and Immobilized Lactobacillus plantarum and Lactobacillus fermentum **M.R. Javed**, H. Abbas, M. Usman and S. Nazir	**Dr Muhammad Rizwan Javed**, Government College University Faisalabad, **Pakistan**
11:45-12:00	Ultrasound Enhanced Release of Active Targeting Liposomes Used for Cancer Treatment N.M. Salkho, V. Paul, P. Kawak, R.F. Vitor, A.M. Martin, **N. Awad**, M. Al Sayah, G.A. Husseini	**Dr. Nahid Awad**, American University of Sharjah, **UAE**

December 6, 2017

Session III. B, Joint Nanotech ME 2017 / Surtech ME 2017: Nanotechnology for environment applications

Conference Room Dubai D (First floor)

Session chairs:
Dr. Muataz Ali Atieh, Qatar Environment and Energy Research Institute, Qatar
Dr. Palaniswamy. Suresh. Kumar, Environmental & Water Technology Centre of Innovation (EWTCOI), Singapore

09:00-09:15	Novel Ionic Liquids based Nanocomposite Catalysts for Direct Conversion of CO2 and Methanol into Dimethyl Carbonate A.A. Pawar, A.A. Chaugule, A.H. Tamboli and **H. Kim**	**Prof. Hern Kim**, Myongji University, **Rep. of Korea**.
09:15-09:30	Nanopyroxene Grafted with β-CD Polymer for Produced Water Treatment **G. Nafie**, G. Vitale and N.N. Nassar	**Ms. Ghada Nafie**, University of Calgary, **Canada**
09:30-09:45	Modeling and Experimental Study of Carbon dioxide capture in an Absorption column using Nanofluid **M. Arivazhagan**, A. Krishnan and D. Navamani Kartic	**Dr. M. Arivazhagan**, National Institute of Technology - Tiruchirappalli, **India**
09:45-10:00	Ultrasound Assisted Oxidation of p-nitroaniline by Synthesized Ferroferric Oxide Encapulated Guaran Nanocomposite J. Balachandramohan, M. Midhun Kumar and **T. Sivasankar**	**Dr. Thirugnanasambandam Sivasankar**, National Institute of Technology Tiruchirappalli, Tamilnadu, **India**
10:00 - 10:30 Coffee Break		
10:30-10:45	Polyelectrolyte coated electrospun Polyacrylonitrile (PAN) Nanofiber membrane to remove Cu2+ metal ions **P. S. Kumar**, G.E. Ling, J. Sundaramurthy and G. Sing	**Dr. Palaniswamy. Suresh. Kumar**, Environmental & Water TechnologyCentre of Innovation (EWTCOI), **Singapore**
10:45-11:00	Effect of different parameters on the properties of prepared cellulose acetate membranes **M. Silva** and M.T. Pessoa de Amorim	**Dr. Monica Silva**, University of Minho, **Portugal**
11:00-11:15	AlOOH-TiO2 dual nanostructures with anti-oil fouling nature for oil-water separation **S.M. Yoon**, E. Yu, H. Lee, K. Hwan Oh, S.Nahm and M-W. Moon	**Ms. Sun Mi Yoon**, Korea Institute of Science and Technology, **Rep.of Korea**
11:15-11:30	Corrosion monitoring of gold and silver nanoobjects in drinking water vs. simulated body fluid **M. Halama**, M. Makowska-Janusik, A. Kovalcikova and V. Violani	**Dr. Maros Halama**, Technical University of Kosice, **Slovak Republic**

Posters Sessions

December 4, 2017
Posters Session I: Nanotech ME 2017 / Surtech ME 2017

Posters / Coffee break area - Sheikh Maktoum Hall

N.	Poster Title	Author/Affiliation/Country
1	Synthesis of a new artificial linker resorc[4]arene-based system for immunosensors development **E. De Paolis**, F. Ghirga, C. Ingallina, C. Tortolini, L. Mangiardi, F. Mazzei, B. Botta, D. Quaglio and **S. Corradi**	**Dr. Elisa De Paolis**, Sapienza University of Rome,, **Italy**
2	Synthesis, Growth and Characterization of Acetophenone-4-Quinoline-D Chalcone Single Crystal: A Potential Nonlinear Optical Material **A. Narayana Prabhu**	**Dr. Ashwatha Narayana Prabhu**, Manipal University, **India**
3	Synthesis of Ni(OH)2/ZnO Core-Shell Nanostructured Electrodes for Improving Supercapacitor Performance by a Hydrothermal Method and Atomic Lyer Deposition **S-H. Kwon** and J-H. Ahn	**Prof. Se-Hun Kwon**, Pusan National University, **Rep.of Korea**
4	A Study of HMDSO plasma during nanoparticles growth using sinusoidal Pulse Low Frequency plasma polymerization **Y. Fermi**, S. Sahli, M. Kihel and P. Raynaud	**Mr. Fermi Youcef**, Freres mentouri constantine University, **Algeria**
5	Hyper-Crosslinked Polymers and Nanocomposites realized through a versatile high yield process R. Castaldo, R. Avolio, M. Cocca, G. Gentile, M.E. Errico, **M. Avella**, C. Carfagna, V. Ambrogi	**Dr. Maurizio Avella**, Institute for Polymers, Composites and Biomaterials-NRC, **Italy**
6	One step facile synthesis of hetero structured Ag-Ni bimetallic nanoparticles by seed less approach **S. S. Alruqi**, S.A. Alzahrani and S.A. Al-Thabaiti	**Ms. Sarah Saad Alruqi** King Abdulaziz University, **Saudi Arabia**
7	Imaging of the optical response of single nanoparticle spatially oriented and shaped by ion irradiation **A. Slablab**, L. Turquet, M. Kauranen, C. Ulysse, P. E. Coulon and G. Rizza	**Dr. Abdallah Slablab**, Tampere University of Technology, **Finland**
8	Ammonia sticking on surfaces **M. Ben Yaala**, L. Marot, R. Steiner, L. Moser, G. De Temmerman, C.Porosnicu, C. Lungu, M. Oberkofler and E. Meyer	**Mrs. Marwa Ben Yaala**, University of Basel, **Switzerland**
9	Design of Lubricating Compositions Based on Nanoscale Potassium Polytitanates Modified by Transition Metals A. Gorokhovsky, A, Azarov, V. Safonov, **A. Durakov**, E. Tretyachenko and A. Tsiganov	**Dr. Andrey Durakov**, Yuri Gagarin State Technical University of Saratov, **Russia**
10	Alkanolamine functionalized N, S co-doped reduced graphene oxide for high performance supercapacitor application **M. Khandelwal** and J.S. Chung	**Dr. Mahima Khandelwal**, University of Ulsan, **Rep. of Korea**
11	Microanalysis of Interfacial Tranzition Zone between Surface Modified Polymeric Fibers and Cement Matrix **Z. Prošek**, J. Trebal and V. Hrbek	**Mr. Zdeněk Prošek**, Czech Technical Unversity in Prague, **Czech Republic**
12	Interaction Enhancement between Glass Micro-fiber Reinforcement with Cement and Lime-based Matrix **J. Trebal** and Z. Prošek	**Mr. Jan Trejbal,** Czech Technical Unversity in Prague, **Czech Republic**
13	Nanotechnology trend analysis using Google Trend and Data Mining Method for NanoInformatics **S. Bae** and S. Kang	**Dr. Seoung Hun Bae,** Korea Institue Science and Technology Information, **Rep. of Korea**

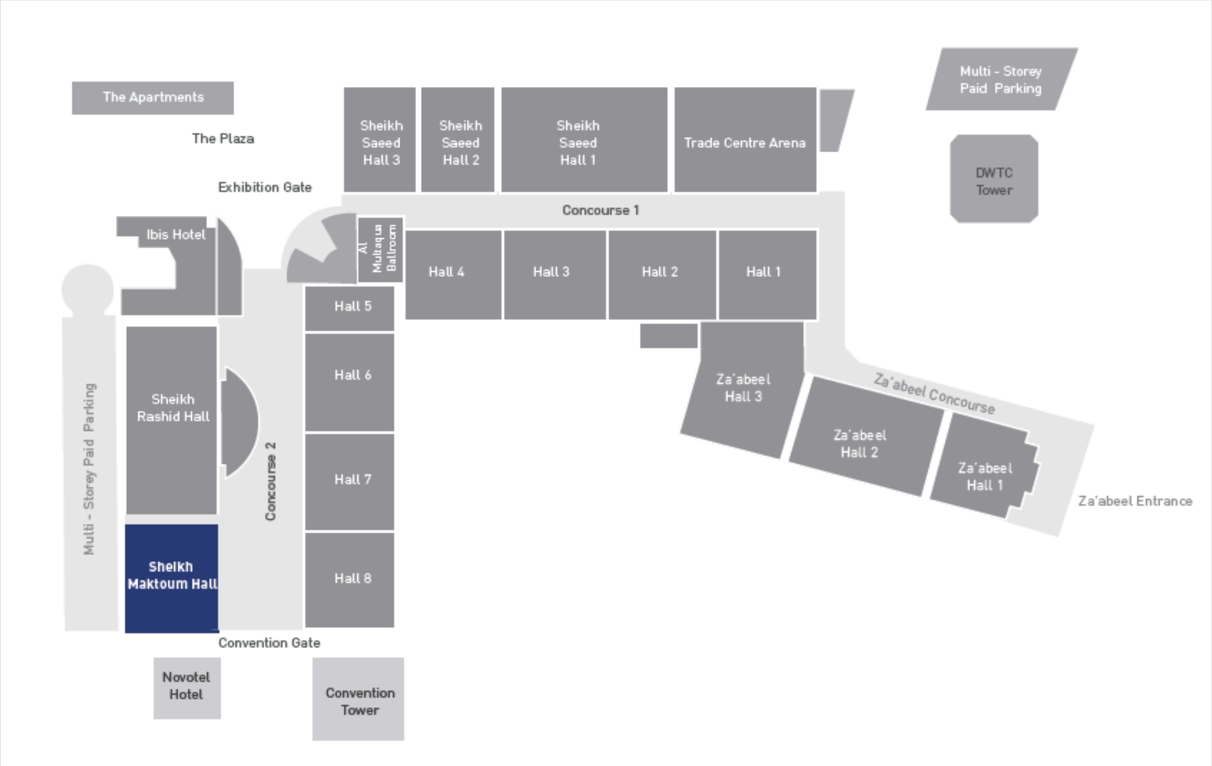
December 5, 2017
Posters Session II: Nanotech ME 2017 / Biotech ME 2017

Posters / Coffee break area - Sheikh Maktoum Hall

N.	Poster Title	Author/Affiliation/Country
1	Thermo-Electrochemical Cells for Low-Grade Waste Heat Conversion **I. Burmistrov**, Artyukhov, A. Shindrov, N. Gorshkov and A. Gorokhovsky	**Dr. Igor Burmistrov,** Yuri Gagarin State Technical University of Saratov, **Russia**
2	Enhanced self-cleaning performance of Ag-F-codoped TiO2/SiO2 thin films B-M. Kim and **J-S. Kim**	**Prof. Jung-Sik Kim**, University of Seoul, **Rep. of Korea**
3	Photocatalytic decolourization of (2-((10-decyl-10H-phenothiazin-3-yl)methylene)malononitrile) by ZnO and TiO2 nanoparticles R.M. El-Shishtawya, **F.A.M. Al-Zahrani**, N.S. Awwd, M.S. Hamdy and A.M. Asiri	**Dr. Fatimah A.M. Al-Zahrani**, King Khalid University, **Saudi Arabia**
4	Study of visible light sensitive CeO2 incorporated mesoporous TiO2 photocatalyst **S. Shamaila** and A. K. Leghari Sajjad	**Prof. Sajjad Shamaila**, International University Islamabad, **Pakistan**
5	Tin Oxide Nanoparticles Deposited by MAPLE for Conductometric Gas Sensors **M. Dumitru**, A. Niculescu, F. Dumitrache, M.Filipescu, Ion Morjan and M. Dinescu	**Dr. Marius Daniel Dumitru**, National Institute for Lasers, Plasma and Radiation Physics, **Romania**
6	Study of the estimation of inhibitory efficiency in the pipeline corrosion prevention. Case of Hassi-Messaoud A. Belaid, **H. Boutefnouchet**, M. Meraissia and B. Benouis	**Ms. Hafida Boutefnouchet**, University Badji-Mokhtar, **Algeria**
7	G-quadruplex-based luminescent probe and graphene oxide biosensor for RNA virus detection **J. Min**, C. Baek, S. Hee Chung, H. Jin Yoo,Y. Kim and W. Nyoung Lee	**Prof. Junhong Min**, Chung-Ang University, **Rep.of Korea**
8	Preparation and Characterization of Cerium Oxide Nanoparticles for Biomedical Applications **E. Erdal**, S, Malekghasame, O. Akbal, T. Vural, M. Demirbilek, N. Ugurlu and E.B. Denkbas	**Ms. Ebru Erdal**, Aksaray University, **Turkey**
9	Optical Glucose Sensors Based on Imprinted Nanopatterns in Hydrogel System **Y. Alqurashi** and H. Butt	**Mr. Yousef Alqurashi**, University of Birmingham, **United Kingdom**
10	Silk Protein Based siRNA Nanocarriers to be used in Larynx Cancer Therapy: Cellular Interactions Studies E. Yalcin, **G. Kara**, E. Celik, F. Alpaslan Pinarli, G. Saylam, C. Sucularli, S. Ozturk, E. Yilmaz, O. Bayir, M.H. Korkmaz and E.B. Denkbas	**Ms. Goknur Kara**, Hacettepe University, **Turkey**
11	Controlled protein corona orientation on the surface of nanoparticle and their influence on nanoparticle-cell interactions **K. Alnahdi**, D. Garry, L. Herda, E. Polo, L. Adumeau and K. Dawson	**Ms. Kholoud Alnahdi**, University College Dublin, **Ireland**
12	The role of CL-11, a recognition component of the lectin activation pathway of complement in pneumococcal infection **I. Al-Karaawi**, P. Andrew, N. Lynch and W. Schwaeble	**Ms. Ibtihal Al-Karaawi**, Leicester university, **United Kingdom**
13	Screening of lytic phages against multi-drug resistant uropathogenic Escherichia coli **D. Sadeghi**, Z. Moradpour and A. Ghasemian	**Ms. Dorna Sadeghi,** Urmia University of Medical Sciences, **Iran**
14	Quantitative force measurements using amplitude modulation force spectroscopy: Application to soft-matter **T. Souier** and Y. Al Habsi	**Dr. Mohammed Tewfik Souier**, Sultan Qaboos University, **Oman**
15	Magnesium Silicates Nanoporous Materials For Removal of Organic Pollutants in Water **S. Al-Thabaiti** and K. Narasimharao	**Prof. Shaeel Al-Thabaiti,** King Abdulaziz University, **Saudi Arabia**

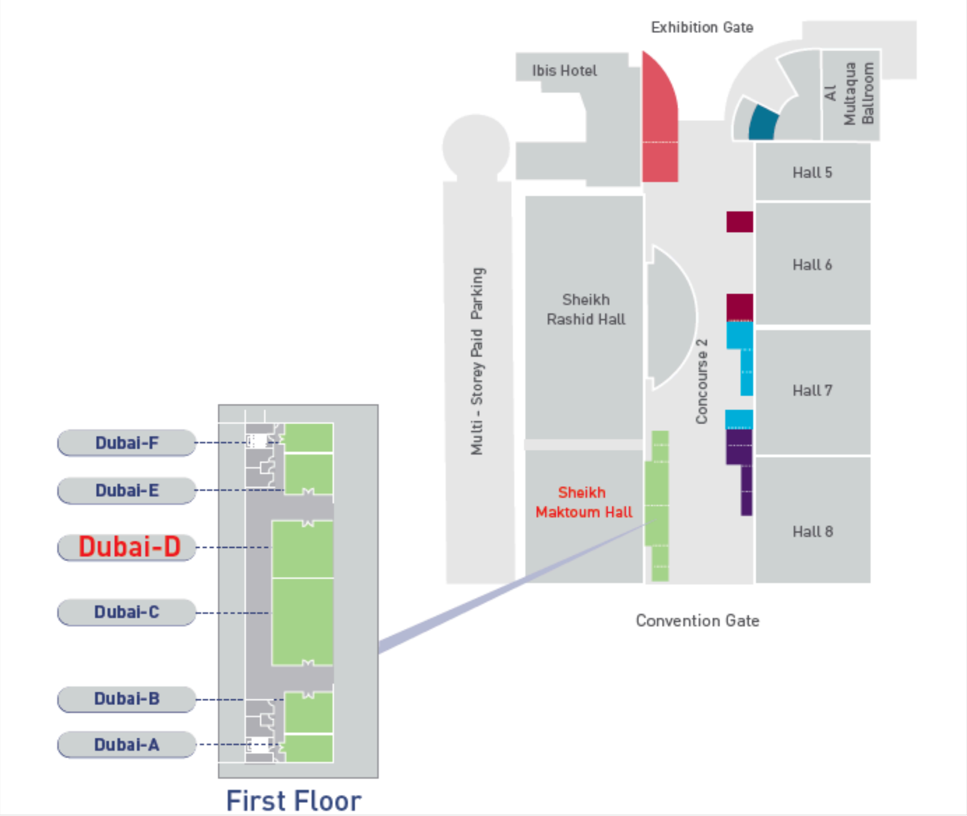
Sheikh Maktoum Hall location

Details for She Sheikh Maktoum Hall are available under:
http://www.dwtc.com/en/complex/Pages/Sheikh-Maktoum-Hall



Conference Room Dubai D location

The conference room Dubai D is located above the Sheikh Maktoum Hall. Please follow the available signage on-site to locate it.



Exhibitors List

Corial France

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Fax: +33(0) 4 76 24 53 81
Email: e-bernard-moulin@corial.com
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Nanotech ME 2017 Session I:

Nanomaterials Fabrication, Characterization and Properties

Near term commercial applications for Graphene, Composites and Conductive Pastes

Ray Gibbs
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Abstract:

The potential for graphene and other nano particles to significantly enhance material properties has been well documented. However, as carbon is inert and does not mix well with other materials it needs to be homogeneously dispersed and bonded into the host material in order to realise its potential. There are hundreds of "graphene's" in the market today and all display different characteristics. Knowing which one works best and applying a sympathetic surface treatment for a specific application is the Haydale expertise. This functionalisation treatment plus the years of processing know how sets Haydale apart in the ability to commercialise nano materials.

For industry to adopt these new materials we need to demonstrate a repeatable and cost effective functionalisation process that is scalable and can be tailored to the specific requirement. One of the challenges industry faces is that there is currently no standard definition of graphene which means that R&D and general procurement departments may not know exactly what it is they are buying nor be able to replicate test results with a subsequent batch of material. Industry requires a standardisation of materials to remove this uncertainty.

Recent work at Haydale has now confirmed significant improvements in electrical, thermal and mechanical performance of Carbon Fibre pre preg, opening up many applications NOW. These breakthroughs plus new pastes for bio medical sensors offers real commercial opportunities for Graphene, something the world has been waiting

Further, in order to persuade industry to adopt the new materials we need to be able to incorporate the functionalised materials into existing production facilities thus avoiding the need for replacement of existing capital equipment. Ray Gibbs will examine these challenges and explain how Haydale has established a consistent supply chain of the nanomaterials and are addressing the commercial adoption challenges through the establishment of Centres of Excellence in strategic locations across the globe.

Biography

Ray is a Chartered Accountant, and former Deloitte audit and corporate finance partner for 9 years. He has over 20 years' experience in high technology and fast moving consumer goods businesses and is a former CFO of Chemring Group Plc. Ray was part of Haydale Graphene Industries' management team that acquired Haydale Limited in 2010, and has been immersed into the graphene and nano world for 5 years. An accomplished international speaker now seen at many Graphene conferences, Ray offers a rare insight into industry and the ability to make the bridge with the academic world.

Novel Types of Multifunctional Micro/Nano-Architected Materials

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Abstract

Design of new materials that are durable, lightweight, and environmentally sustainable are commonly inspired by natural materials and composites. However, imagine if we can design materials in a similar way that structural engineers design strong and sustainable architected structures. In fact, as engineers we are no longer limited to the natural material patterns; we can design our own complex architected materials that may perform even better than the ones that already exist in nature. Due to the recent advances in additive manufacturing or 3D printing, fabrication of such complex architected materials is becoming possible at different length scales. The objective of this talk to present a new and novel types of architected materials where their mechanical and physical properties are controlled by their internal topology or architecture and not only by their composition. The architecture of these materials and composites are based on the mathematical triply periodic minimal surfaces (TPMS) that allow us to design new types of multifunctional materials and composites with superior mechanical and physical properties. Metallic and polymeric based architected TPMS materials and composites are fabricated using macro and micro 3D printing technologies depending on the length scale of interest and desirable properties. Analytical and computational models are used to develop insights about their obtained properties and guide their further developments. Potential applications of these material and composites are demonstrated in automotive, aerospace and defense (lightweight and damage-tolerant materials), the energy (energy storage, heat transfer), semiconductor (heat dissipation), and oil and gas (damage resistance, corrosion resistance) sectors.

Challenges on modeling of grain size impact on polycrystalline metallic behavior

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Abstract:

An extension of a micromechanical approach already developed is proposed to predict the grain size effect on the enhancement of the mechanical strength of metals. As a new development, the dislocation dynamics looks decisive in this work for characterizing these materials where grain boundary is taken into consideration by a thermal diffusion concept. In the used self-consistent model, the overall kinematic hardening effect is naturally described by the interaction law. Within the framework of small deformations hypothesis, the elastic part is treated at the granular scale supposing to be uniform, isotropic and incompressible neglecting the grain rotation. The heterogeneous inelastic deformation is locally determined using the slip theory. At this level, the inelastic flow of polycrystalline structures is a manifestation of their heterogeneous deformation pattern principally influenced by the presence of microstructural inhomogeneities. Consequently, the microstructure heterogeneities profoundly affect the overall material strength and response. The intragranular isotropic hardening is considered at the crystallographic slip system level describing the interaction between the activated slip systems within the same grain. As an approximation, the granular strain rate is assumed to be uniform in each grain. The transition from the single to polycrystal response is performed by homogenization and averaging procedures.

Due to the grain size impact on the yield strength, the new model extension describes fairly well the effect of the grain size on the strain-stress behavior of the nanocrystalline and the ultrafine grained materials. This development is validated by some experimental polycrystalline metals like copper and aluminum..

Keywords: Ultrafine-grained structures; Nano-crystalline materials; Self-consistent modeling; Non-incremental interaction law; dislocation kinematics.

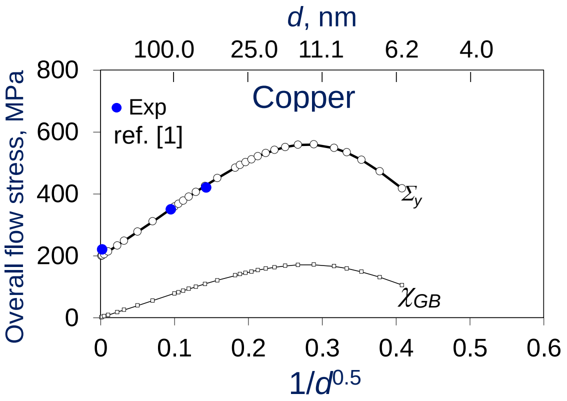

Figure 1: Figure illustrating the dependence of the flow stress on the copper grain size using the experimental flow stresses for the three copper grain sizes. The model prediction shows that the yield stress (Σ_y) increases proportionally with decreasing the inverse square root of grain size for conventional, *ufg* and *nc* materials following the Hall–Petch plot. However, as the grain size further decreases below 10 nm, the yield stress starts to decrease leading to the reverse Hall-Petch plot.

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Application of bioleaching solutions for the biosynthesis of metal nanoparticles

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Abstract:

Biological leaching of minerals induces two processes: mineral dissolution and mineral oxidation. These processes transfer the metal from the solid phase to the solution [1].This work has focused mainly on the removal of metal ions from solution in the form of nano- and micro-scale particles. Low grade sulfide ores or mineral wastes can be treated by bacteria in order to metal recovery. *Acidithiobacillus ferrooxidans* bacteria (acidophilic prokaryote) were used to bioleaching of mineral waste.

For plant exstract preparation are used plant parts such as leafs, roots, and seeds. These extracts contains polyphenols, proteins, and alkaloids, which able to reduce the metal ions. The production of metal nanoparticles by reduction using plant extract is very simple process. The plant extract and aqueous solution of metal ions are mixed well at high temperature. Two aqueous extracts were prepared from *Aloe vera* and *Geranium (Pelargonium graveolens)*. These extracts were obtained from both dry and green leaves. The bioleaching solutions were obtained from the bioleaching of copper shale (*Kupferschiefier*), [2] nickel laterite low grade ores, and uranium solid waste [3]. The synthesis processes were checked due to absorption peaks using an UV-vis spectrophotometer. Uranium nanoparticles were deposited on the surface of hematite crystals [3]. Detailed characterization of synthesized metallic nanoparticles was carried out by combining the UV-vis absorption spectroscopy, FTIR spectroscopy, TEM imaging, and zeta potential measurements. The morphology of the biosynthesis nanoparticles was compared with the morphology of chemically prepared nanoparticles using sodium borohydride.

Keywords: bioleaching, mineral waste, leaf extract, metal nanoparticles, copper, nickel, uranium oxide, hematite, zeta potential, size distribution.

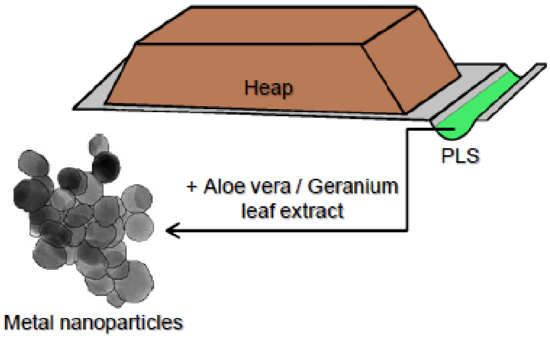

Figure 1: Biosynthesis of metal nanoparticles from Pregnant Leach Solution (PLS) using leaf extracts of *Aloe vera* and *Geranium*.

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Graphene-2D Materials Nanoelectromechanical (NEM) Devices and Its Extreme Sensitivity

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Abstract:

Graphene has an ultra-high Young's modulus of 1 TPa, which makes it a promising candidate for future nanoelectromechanical (NEM) applications. The graphene NEM (GNEM) switches have potential to realize minimized electrical leakage, sharp switching response, low actuation voltage and high on/off ratio. Despite these applications, GNEM devices give a unique platform to realize high sensitivity gas molecules detection. It is due to the graphene exceptional low electronic noise characteristics and suspended nature of graphene channel in GNEM devices. Substrate induced noises to the graphene channel is avoided by the physical isolation of the GNEM channel from the substrate.

GNEM switches are fabricated using the bottom-up procedure to get suspended graphene with a polymer sacrificial spacer. In these GNEM switches, low pull-in voltage of less than 2V is achieved [1]. This pull-in voltage is compatible with the conventional, complementary metal-oxide semiconductor circuit requirements. We realized double-clamped beam and cantilever graphene nanoelectromechanical (GNEM) switches with local top actuation electrode [2]. Recently, we have realized graphene-graphene contact NEM switches with 2D matreial as a gate dielctric due to the low stiction van der Waals binding energy.

In order to realize the extreme sensing capability, the suspended bilayer graphene GNEM switches are exploited. Using the electrostatic force, the central part of the suspended beam is pulled-down to the bottom metal electrode. This novel design of suspended graphene beam architecture avoids any further mechanical deflection of pulled-down beams on to the substrate when the electric field is applied from the substrate. The step-like changes in the graphene beam resistance with a quantized value of ~62 Ω are measured when exposed to low concentration CO_2 molecules. These discrete responses are clear evidence to individual CO_2 molecule adsorption onto the slanted graphene beam. In order to enhance the molecular adsorption rate, the electrical field is introduced around the suspended graphene region by applying the back-gate voltage. The first-principles calculations and molecular dynamics simulations elucidate the role of van der Waals interaction between molecules and graphene during detection and the back gate effects on accelerating the molecules adsorption [3-4].

Keywords: Graphene, Nanoelectromechanical (NEM) swtiches, Single molecule sensor, Ultra-low power switches

Acknowledgement: This work is supported by Grant-in-Aid for Young Scientists (B) No. 16K18090, Challenging Exploratory Research No. 16K13650, and Grant-in-Aid for Scientific Research (S) No. 25220904 from Japan Society for the Promotion of Science.

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On the Effect of Secondary Phases on Deformation Nanostructuring and Strengthening of Aluminum Alloys

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Abstract:

Precipitate stimulated nucleation (PSN) effect is widely used to process fine-grained (with a grain size up to 1 μm) products out of matrix type alloys on different bases, involving aluminum alloys [1, 2]. The potential of this phenomenon to fabricate nanocrystalline (NC) metallic materials, using severe plastic deformation (SPD) is not well studied yet [3-5].

Influence of precipitates, formed upon an alloy prior-SPD heat treatment, on development of NC structure, hardness and tensile strength of age-hardenable aluminium alloy of different composition and containing transition metals (Mn, Zr and Sc), was investigated. Disc-shape samples diam. 20 x 1 mm, cut out from cast and homogenized ingots, and wrought products, were deformed by high-pressure torsion (HPT) up to 10 revolutions under 6 GPa pressure at room temperature. Prior HPT, the alloys were solution treated with different routes, water quenched and annealed in a wide temperature-time range in order to change their structural heterogeneity. That is, to vary size and densities of precipitates of two types: predominantly disk-shape aluminides of transition metals (dispersoids), that were formed under homogenization and further alloy hot processing, and main strengthening phases, that were formed under aging and overaging of pre-quenched alloys.

It has been shown that the most developed non-equilibrium NC structure with a (sub)grain size less than 100 nm was processed in the pre-quenched alloys via continuous dynamic recrystallization and fragmentation. Nanostructuring of the matrix was also accompanied by the alloys abnormal high strengthening, resulted in the record tensile strength and hardness at ambient temperature. HPT of the artificially aged alloys (strengthened close to maximum aging responce), on the opposite, could process partially or even completely unrecrystallized, highly work-hardened structure, consisting of dense dislocation walls and demonstrating less strength parameters. Such a behaviour was reasoned by the suppression of recrystallization of the alloys matrix owing to homogenization of slip with no formation of deformation bands, being one of the main character of defomation nanostructuring. Overaging led to coarsening of the main strengthening phases and their less densities, thereby allowing occurrence of recrystallization with formation of new (nano)grains of larger size. It has been found that the alloys structural (deformation) strengthening in all pre-annealed conditions did not compensate their softening due to precipitation and coagulation of phases, thus demonstrating less strength and hardness than in pre-quenched and severely deformed alloy conditions.

The mechanisms and nature of the alloys behavior observed are discussed in details.

Conclusions and recommendations had been made on the principle of otimization the alloys structure to process (control) two-level alloys nanostructuring (of the matrix and precipitates) and enchanced balance of mechanical properties.

Keywords: Aluminium alloy; severe plastic deformation, nanocrystalline structure; precipitates, strength.

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Continuous-Flow Assisted Method for Scaling up Nanoparticles Synthesis

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Abstract:

Development of nanoparticles gives a lot of benefit to modern industrial technology. They can be used in a very small quantity with a significant impact. For example, less than 0.5-1 g of quantum dots in LCD display widens its color gamut by hundred times. Adding silver nanoparticles to polymer of fiber materials imparts considerable antimicrobial or electro-conductive properties. As nanoparticles demand is increasing, higher production capabilities are required. Currently, the traditional way to synthesize nanoparticles is a batch processing. This method is efficient in the lab scales only where small volumes of reactants are used. For industrial scales, batch processing has several drawbacks that need to be considered such as a poor scalability and lack of reproducibility. In the other hand, scaling up method by using a big volume reactor also has drawbacks, such as high gradients of temperatures and reactant concentrations which can lead to large size distribution nanoparticles and with lower quality. This study will focus on a new method of nanoparticles synthesis called continuous-flow assisted method, particularly with separate nucleation and growth stages (Fig.1). Continuous-flow chemistry is the concept of continuously pumping reagents through a reaction and mixing vessel, where multistep clean synthesis could be carried out in a continuous flow-process manner and is readily applicable to automation. We will discuss the synthesis parameters that can be controlled in this system and their effects to the quality of the obtained nanoparticles. Furthermore, the advantages of this method in comparison with traditional batch techniques will be also provided. This study will report our latest results on the synthesis of nanoparticles including PbS quantum dots and metallic nanoparticles such as silver, platinum-nickel and platinum-copper alloys [1-4]. We believe that this method can give new insights on how to produce nanoparticles for large scale industrial application.

Keywords: nanoparticles, quantum dots, metallic nanoparticles, flow synthesis, batch synthesis

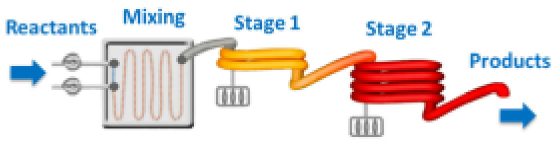

Figure 1: Figure illustrating the flow reactor system for large scale nanoparticles synthesis

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Understanding the technology behind world’s highest resolution micro 3D printer and its applications

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Abstract:

The achievements of the two-photon polymerization based world’s highest resolution micro 3D printer “Photonic Professional GT” will be presented. The device offers a defined control on the feature sizes and resolutions ranging from nanometer to micrometer scale and accessible print area of ~ cm^2. This versatility has opened new frontiers in the field of photonics, optics, microfluidics, life sciences, bio-medical, microrobotics and many others. All this is made possible by the advancements in the software and hardware design of the printer as well as high level of materials research that enables the realization of ideas only with few mouse clicks.

The talk will focus on customer’s applications in various fields. Prominent examples include microfluidic nozzles for the precise formation of droplets, sprays or jets,[1] high-fidelity replication of human trabecular bone structure,[2] photonic particle-accelerator,[3] high strength ceramic polymer composite (mechanical metamaterials),[4] plasmonic color display,[5] plasmonic nanoantenna (fig. 1),[6] fertilization-assisting micromotors (spermbots, fig. 2),[7] and many examples from bio-mimetics field.

All these excellent achievements were possible only because of a precise control on the geometry and surface of the printed objects at sub-micron level. The decade of trusted use of this technology has found its way to several industrial applications as well. This presentation will therefore, cover the latest advances utilizing this art of 3D microprinting that has made small things matter across the globe.

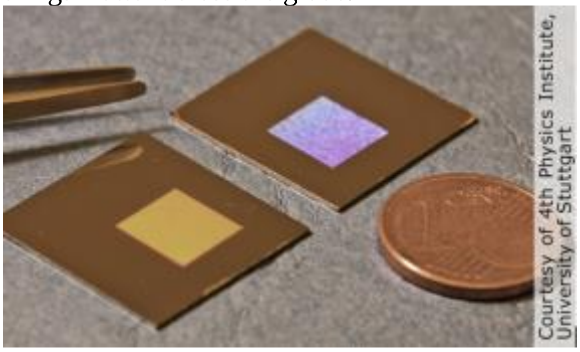
Courtesy of 4th Physics Institute, University of Stuttgart

Fig. 1. The Photonic Professional GT enables patterning of polymer serving as an etch mask on a gold layer covering an area of tens of mm^2. Establishing an easy-to-use alternative for electron beam lithography for fabrication of plasmonic nanoantenna with line widths down to 105 nm.

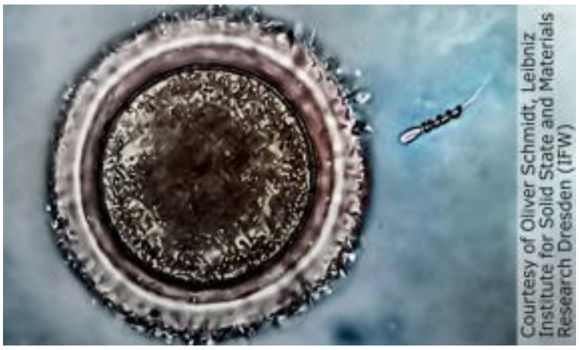
Courtesy of Oliver Schmidt, Leibniz Institute for Solid State and Materials Research Dresden (IFW)

Fig. 2. 3D printed polymer microhelices using Nanoscribe’s printer are coated with nickel and titanium allowing the helices to act as motors in a magnetic field and providing biocompatibility, respectively. Catches sperm and drives it to the egg.

Keywords: Maskless lithography, highest precision additive manufacturing, microscale fabrication, 3D laser lithography

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2. DOI: 10.1016/j.actbio.2014.05.032
3. DOI: 10.1364/OE.20.005607
4. DOI: 10.1073/pnas.1315147111
5. DOI: 10.1038/ncomms8337
6. DOI: 10.1021/acsphotonics.5b00141
7. DOI: 10.1021/acs.nanolett.5b04221

Optical characterization and related applications of cerium oxide nanoparticles

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Abstract:

Depending on its special characteristics, cerium oxide (ceria) nanoparticles could be synthesized to have formed oxygen vacancies (O-vacancies) to be the proper probes for different elements such as dissolved oxygen, radicals, and tiny particles which could be transferred between vacancies through hopping mechanism [1-3]. In addi-tion, the formed O-vacancies are associated with incremental conversion of cerium ions from the Ce^{4+} states to the Ce^{3+} ones and vice versa. The tri-valent cerium ions are correlated to the direct transition of fluorescence green emission under near-UV excitation. Hence, any adsorption of quenchers in the vacancies would result in lowering the fluorescence intensity or fluorescence quenching, and consequently that could be considered the sensing technique of such quenchers using the host nanoparticles. Moreover, ceria nanoparticles can be doped with other lanthanides or tri-valent metals to increase the O-vacancies concentrations and consequently the sensitivity to sense the targeted quenchers. Also, these nanoparticles can be embedded inside electrospun nanofibers to offer solid nanocomposite optical sensing material in addition to the aqueous nature of ceria nanoparticles solutions. These different nanostructures based on cerium oxide core are useful in different applications both such as envioronmental sensors and biomedical engineering

Keywords: ceria nanoparticles, fluorescence quenching, peroxides, tiny-particles, O-vacancies, optical nanosensors.

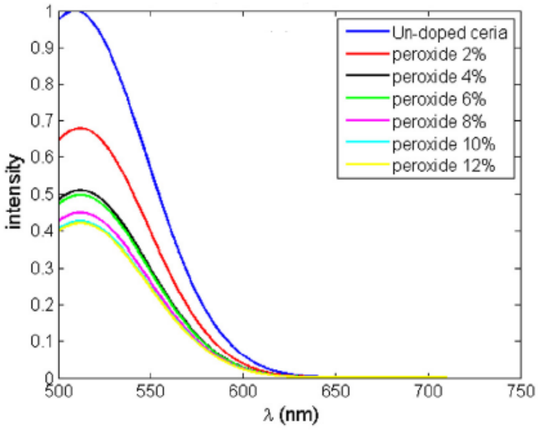

Figure 1: Fluorescence intensity quenching due to increased peroxide concentrations exposed to ceria nanoparticles.

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Structural and dynamical study of semicrystalline block copolymers

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Abstract:

The periodic nature of copolymeric matrices has drawn the attention of scientists and engineers working in a field of microelectronics and nanolitography. Spontaneous phase separation of block copolymers (BCPs) in bulk leads to well organized and nanoscopic domain architectures providing unique templates[1,2] , whereas dilution of amphiphilic BCPs develops micellar or vesicular structures potentially serving as nanocarriers in medicine. BCPs based nanolithography is believed to compete with standard lithographic techniques and can provide highly ordered domain arrays characterized by extremely low feature size (<10 nm) surpassing even photolithographic limits. Accordingly, BCPs exemplify particularly interesting systems in terms of the study of molecular dynamic under confined geometries conditions. Linkage of two blocks revealing contrastingly different thermal properties (i.e. poly(styrene-b-dimethylsiloxane) or poly(styrene-b-ethylene oxide)) leads to the substantialy high mobility gradient at the domain interfaces. As a result, cooperative motions of the soft component are influenced by the presence of rigid organic scaffold made of the stiff blocks[3]. It has been shown that the interfacial geometry has an impact on polymer chain mobility. Among copolymeric systems, semicrystalline BCPs represent an exceptionally interesting group due to phenomena concerning confined crystallization and rigid amorphous phase dynamics[4]**.** In order to probe these complex structures two complementary spectroscopic methods (NMR and BDS) were employed and supported by other experimental techniques.

Keywords: block copolymers, self-assembling, semicrystalline polymers, rigid amorphous fraction, structural relaxation.

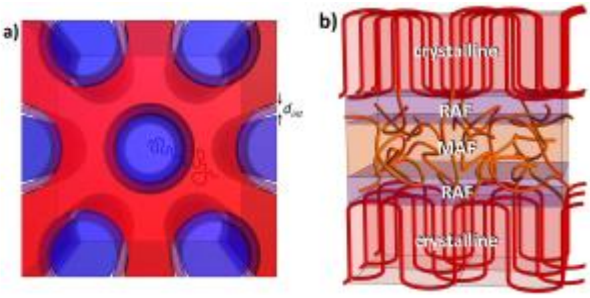

Figure 1: Schematically presented a) cylindrical domain structure and b) complex phase structure of semicrystalline polymer comprising mobile amorphous fraction (MAF) and rigid amorphous fraction (RAF).

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Controlled Synthesis of different ZnO Nanostructures for Sensing Applications

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Abstract:

Low temperature hydrothermal synthesis of different ZnO nanostructures with rational control over their morphology and size is important for a wide range of sensing applications. ZnO nanostructures with different dimensionalities have been synthesized through low temperature hydrothermal techniques. One dimensional ZnO NWs have been synthesized with and without the assistance of a seed layer, with a higher degree of control over their structure, morphology, density and dimensions. The large scale production of two dimensional ZnO nanodisks with a high fraction of exposed polar facets have also been produced through using zinc counter ions with preferential capping capabilities on defined facets. Furthermore, using a multistage hydrothermal synthesis, a range of three dimensional hierarchical ZnO nanostructures grown from initial mono-morphological ZnO nanostructures/seeds has been reported. The growth parameters, such as the nutrient concentration, quantity of polyethylenimine, growth time, and zinc counter ions have had a substantial impact on the morphological properties of the grown structures. Gas sensors based on ZnO nanostructures with different dimensionalities have been fabricated and analyzed. The effect of the exposed polar facets on sensing properties of ZnO nanostructures has been investigated and found to play a crucial role in the overall performance of the gas sensors. Ultraviolet activation mechanisms for ZnO gas sensors has been presented and discussed as a substitute to conventional thermal activation. Finally, an effective approach to enhance the performance of ZnO nanostructured gas sensors by using hierarchical structures instead of their mono-morphological counterparts has been demonstrated. Hierarchically ZnO structures display an enhancement of gas sensing performance and exhibit significantly improved sensitivity and fast response to gases in comparison to other mono-morphological ZnO, such as nanoparticles, nanowires, or nanodisks. In addition to the high surface-to-volume ratio due to its small size, the nanowire building blocks show the enhanced gas sensing properties mainly ascribed to the increased proportion of exposed active (0001) planes, and the formation of many nanojunctions at the interface between initial ZnO nanostructure and secondary nanowires.

Keywords: hydrothermal, sensors, zonc oxide, nanomaterials, nanowires.

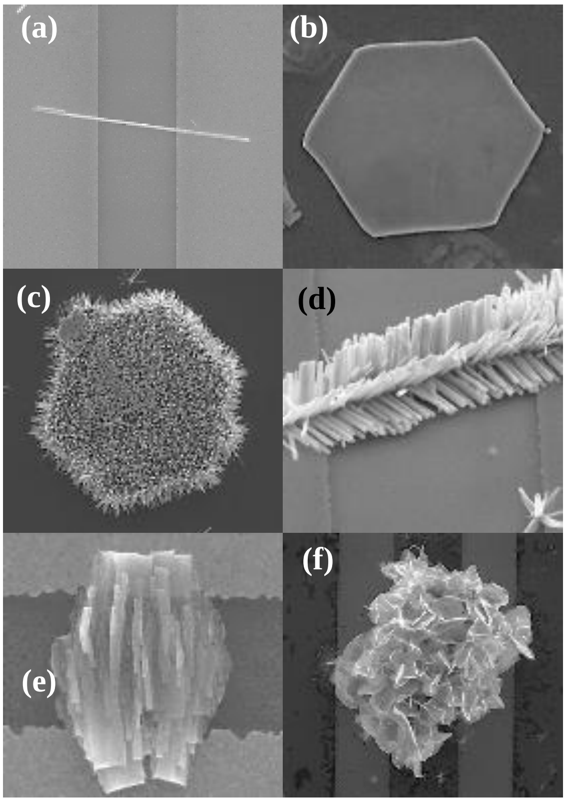

Figure 1. SEM image of (a) nanowire, (b) nanodisk, (c) hierarchical nanodisk, (d) hierarchical nanowire, (e) nanoleaf, and (f) nanoflake.

Influence of thermal processing rate on the structural and morphological properties of Cu_2SnS_3(CTS) prepared using solid state reaction technique

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Abstract:
The copper tin sulfide Cu_2SnS_3 (CTS) is a p-type direct band gap material; its elements are non-toxic and earth-abundant. It can be used in photo thermal conversion of solar energy and as selective radiation filters on architectural windows. The CTS compound was synthesized by solid state reaction method. The influence of soaking time on the structural and morphological properties of these films are investigated. X-Ray diffraction analysis of these compounds prepared with varying the soaking time at 900^0C are found to exhibit tetragonal CTS phase with preferred orientation (1 1 2), (2 2 0) and (3 1 2). The XRD pattern showed that prepared samples do not contain any secondary phases. The grain size calculated using Debye-Scherer's formula was found to be in the range of 34nm-46nm. The chemical composition of the compound estimated using Energy dispersive spectroscopy showed Cu/Sn atomic ratio in the range 0.9 to 1.10.

Keywords: XRD, EDS, Cu_2SnS_3 , Solar absorber material, nano crystalline material

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Synthesis of ZnO nanowires with supercritical carbon dioxide and post heat treatment

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Abstract:
ZnO is a n-type semiconductor material with many interesting properties e.g., piezoelectric, optical, as well as photocatalytic and anti-bacterial activities. Solution based hydrothermal methods are often used to synthesize nanostructures of ZnO. However, these techniques require various chemicals and long synthesis times. This work presents a novel synthesis route for producing photoactive ZnO nanowires using supercritical carbon dioxide. In this method, a galvanized steel substrate was treated with supercritical carbon dioxide in 300 bar and 50 °C for 60 minutes. The reaction was catalyzed using a solution of water, ethanol and copper(II) hexafluoroacetylacetonate. After the supercritical carbon dioxide treatment, the substrate was calcined in 300 °C for 120 minutes. The surfaces were characterized with SEM, FTIR, XRD and optical spectroscopy. The SEM results showed that the calcining did not change the surface morphology of the nanowires. According to the FTIR results, the surface structure had changed from zinc hydroxycarbonate to ZnO after calcining. Presence of ZnO was further confirmed with XRD. Methylene blue test was performed for the ZnO surface to ensure photoactivity of the sample. This study presents a unique and rapid synthesis method that utilizes minimal amount of chemicals for producing nanoscale ZnO structures for photocatalytic applications.

Keywords: supercritical carbon dioxide, zinc, zinc oxide, zinc hydroxycarbonate, nanowire, nanoflower, semiconductor, photocatalytic activity

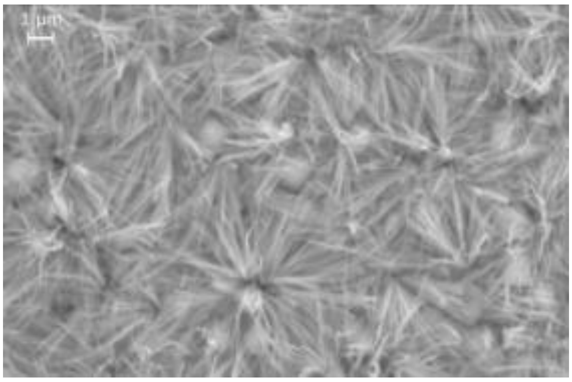

Figure 1: SEM image of the ZnO nanowire surface.

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Effects of Electron Beam Irradiation on Al/n-Si Schottky Diode Parameters

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Abstract:

The effect of electron beam irradiation (EBI) on Al/n-Si Schottky diodes has been studied by I-V characterization at room temperature. The diodes are subjected to high radiation doses of electrons (500, 1000 and 1500 kGy). The diode parameters such as, Schottky barrier height (Φ_B), ideality factor (n) and series resistance (R_S) are extracted by thermionic emission and Cheung models. Schottky barrier height is found to vary from 0.78 eV to 0.84 eV. The diode parameters found to depend on the nature of interface, and irradiation induced defect states. The different transport mechanisms across the irradiated Al/n-Si junctions like thermionic emission of electrons, space charge limited current, tunneling, and tunneling through the trap states are explained. The power law characteristics at different doses have revealed a simple explanation for the Φ_B dependence on the irradiation induced trap states. The study shows that Schottky contact parameters can be controlled by electron beam irradiation at higher doses.

Keywords: Electron beam irradiation, nanoeletronics, Schottky contact, barrier height.

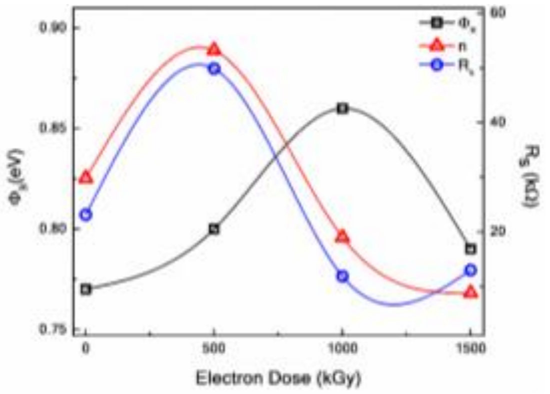

Fig. Variation of Al/n-Si diode parameters irradiated at different radiation doses.

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The Study of Physical Properties of Fractal Graphene Layers

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Abstract:
Currently, intensive research taking place in the world to develop simple low-temperature methods for the synthesis of graphene and related materials. This paper considers a synthesis of graphene using colloidal solution of graphite powder (dissolved in water). Also, ultrasonic vibrations were used in the process of synthesis. Obtained layers were substituted on the silicon, amorphous sapphire, monocrystal salt and plastic surface. Scanning electron and atomic force microscopes are used to study surface profile (Fig. 1) and surface potential (by Kelvin-probe method) of samples. The results of surface potential measurements (-400 ÷ -600 mV) are typical for graphene [1]. We also study the change in the surface potential at the graphene-quartz boundary.

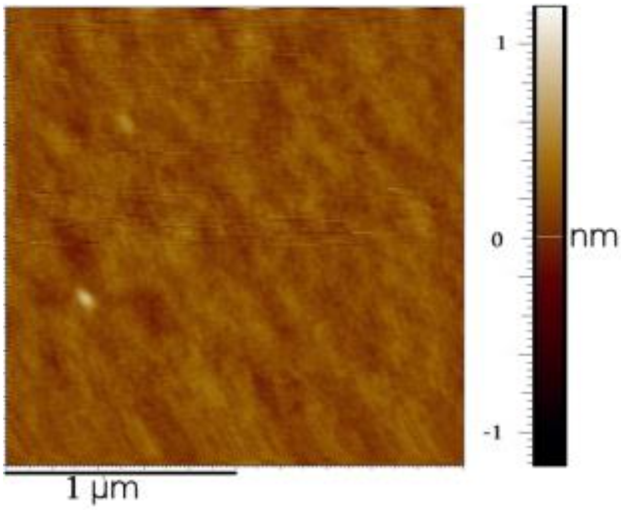

Figure 1: AFM image of surface profile of a self-organized carbon film.

In order to elucidate the internal structure of formed films, the Raman scattering and optical absorption spectrums are studied. The joint analysis of the results and reviews the literature [2, 3] indicates the presence of graphene and graphene oxide.

When change the substrate (from salt to amorphous sapphire) characteristic absorption peak for graphene shifts to higher energy range, due to the dielectric confinement effect. It happens, because in our case, in addition to the quantum confinement, there is also the so-called dielectric confinement, which is due to the fact that the lines of elektric field between the Coulomb pair (exciton) penetrate to the barier zone and are redistribute.

Also, the current-voltage characteristics of these films are obtained for different values of resistance (Fig. 2). The results are discussed in comparison with the results already published articles [4, 5].

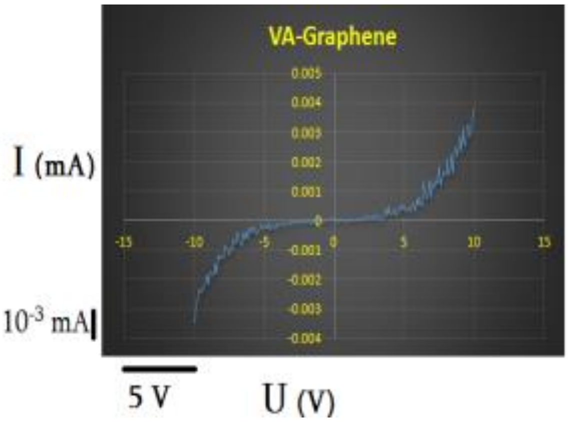

Figure 2: Current-voltage characteristic (for R≈700 kΩ).

Keywords: Graphene,Fractal Nanostructure, AFM, SEM, Raman, V-I charachterics.

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Dynamic Mechanical properties of Oil Palm Nano filler based epoxy Nanocomposites

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Abstract:
The aim of present study is to evaluate the effect of different oil palm nano filler loading (1%, 3% and 5%) on the dynamic mechanical properties of epoxy composites fabricated by hand lay-up. Dynamic mechanical analysis clearly revealed that glass transition temperature *T*g, storage modulus E' and loss modulus E'' of the epoxy nanocomposites are considerably higher compared to pure epoxy composites. Moreover, 3% displays marked decrease in damping factor with relative to pure epoxy composite and the rest. Overall we concluded that the 3% of oil palm-nano filler loading is the optimal to enhance dynamic mechanical properties of the epoxy nanocomposites.

Keywords: Fibres; Epoxy resin; Nanocomposites; Dynamic mechanical properties.

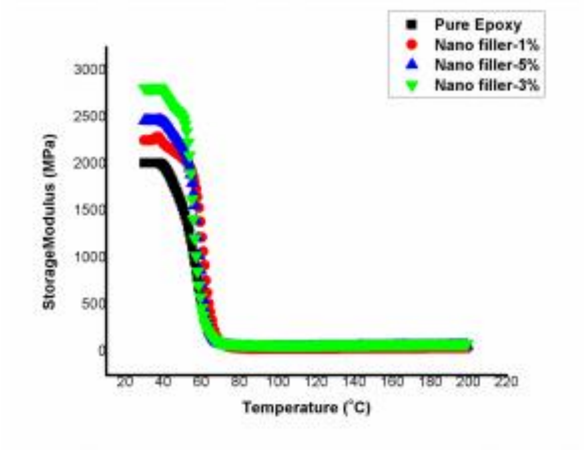

Figure 1: Fig.1 shows the storage modulus (E') versus temperature of (0%, 1%, 3%, 5%) nano filler loading in the epoxy nanocomposites at a frequency of 1Hz. From the graph it is seen that epoxy with (0% filler) showed the minimum E' values. In other study it were already established that epoxy offers low degree of stiffness and consequently have lower storage modulus [1, 2].

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Joint Session I.A:

Surtech ME 2017, Nanotech ME 2017, Biotech ME 2017

Developpement of “bio” Titanium based thin films

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Abstract:
Research on the β-type titanium alloys containing non-toxic elements and non-allergic properties has increased rapidly during the past decade.
The objective of our research work is to develop new biomedical materials in the form of thin films. In this study, we present the super-elastic titanium based thin film Ti-23Nb-0.7Ta-2Zr (TNTZ) deposited by direct current magnetron sputtering.
Different deposition parameters were investigated: morphology, doped elements, …etc. Experimental studies were carried out to characterize the physico-chemical and mechanical properties of the samples’ surfaces by EDX, SEM, AFM, XRD and nanoindentation. The bactericidal activity of coatings was evaluated by inductively coupled plasma mass-spectrometry (ICPMS).
It has been shown that deposition pressure influences the films’ morphology (compact/ columnar morphology).
The XRD spectrograms of TNTZ films showed that the films were single phased with the β-Ti BCC structure.
The nanoindentation measurements showed that deposition of TNTZ films in different reactive-atmospheres (Ar + O_2, Ar + N_2) enhances the hardness and Young’s modulus of films’ surfaces.
The influence of copper doping on the properties of TNTZ films was studied. By increasing Cu content up to 18.6 at.%, the elastic modulus and hardness of films decreased to a copper content of 7%, and increased above. It seems that formation of an amorphous phase leads to increasing mechanical properties.
The biocompatibility tests showed that O-containing TNTZ samples led to higher cells proliferation.
The sputtered TNTZ films containing O or Cu showed bactericidal activity. The antibacterial performance of these innovative coatings suggests a potential application in hospitals, health care facilities, implants, schools and public places.

Keywords: Titanium based thin films, magnetron sputtering, PVD, biointerface, Biocompatibility, antibacterial films, multifunctional coatings, biomedical applications.

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The research of Pt ALD on various textiles materials and understanding of fundamentals behind the surface reactions between Pt and textiles

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Abstract:

Electronic textiles (e-textiles) are electrically conductive textiles which are potentially important for future wearable electronic systems. Recently, we reported that atomic layer deposition (ALD) could be a good method to functionalize conventional non-conductive textiles to conductive textiles just by depositing Pt on cotton textiles without any damage. In this work, we deposited Pt on various thermally weak flexible textiles such as cotton, silk, nomex, nylon, wool and kevlar fibers. Pt was successfully deposited on cotton, silk, nomex, wool, kevlar fibers except nylon fibers. Thus, we investigated the deposition mechanism and surface reactions of ALD Pt on various textiles by using different analytic techniques, such as X-ray photoelectron spectroscopy (XPS), scanning electron microscopy (SEM), transmission electron microscopy (TEM), and density functional theory (DFT) calculation. Pt ALD on the various textiles seems to be hard since it has rare reactive sites of ALD reaction such as surface hydroxyl group. From XPS and DFT calculation, it was found that Pt precursor molecules directly react with chemical species of the reactive sites of cotton and silk fibers. But nylon fibers did not react with Pt precursor molecules. The activation energies for the reactions of HDMP with cellulose of cotton (26.3 kcal/mol for –OH) or silk fibroin (19.5 kcal/mol for –OH, 26.1 kcal/mol for –NH) are smaller compared to that with nylon 66 (36.9 kcal/mol). Therefore, the reactivity of nylon toward adsorption of HDMP is considerably smaller than those of cotton and silk. Thus, we found that ALD Pt layer forms with very high durability on cotton and silk fibers surface through organic-inorganic hybridization. We believe that the functionalized flexible textiles obtained through Pt ALD are promising candidates for various wearable and smart fabric applications as a new platform for future textile electronics.

Keywords: Atomic layer deposition, electronic textiles, deposition mechanism, organic-inorganic hybridization, activation energy

Wear Properties of Detonation Gun deposited Steel Reinforced with Tungsten Carbide particulates

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Technology, Moscow, Russian Federation
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Abstract:

During the last few decades, the Fe-based coating attracted significant attention as a possible replacement to Co- and Ni-based coatings due to its less toxicity and environmental hazards. The mechanical properties of steel coatings can be improved by the addition of hard materials, and as one of the most promising hard phases, tungsten carbide (WC) can produce coatings with superior properties such as higher hardness and wear resistance. Among various deposition techniques, the Detonation Gun Spraying (DGS) is known as one of the most economical and easy to operate thermal spraying methods due to the formation of dense coating with good mechanical properties. An experimental investigation was performed on the wear properties of Detonation Gun spraying (DGS) deposited steel coating and of the same steel reinforced with Tungsten Carbide (WC) particles. The coatings deposited by DGS method was high-quality with a porosity level less than 5%. The phase composition analysis indicated that while the steel coating exhibited almost fully amorphous structure, the steel+WC coating exhibited crystalline structure (Figure 1). In addition to the layered structure which is typical for DGS deposited coatings, the composite coating contained some unmelted WC particles. As it was expected, the hardness of the composite coating was measured higher compared to the steel coating. Despite a negligible difference in the friction coefficients, the wear rate of the steel+WC coating was significantly lower compared to the un-reinforced steel coating)Figure 2).

Keywords: Steel coating, tungsten carbide reinforced coating, detonation gun spraying (DGS), microstructure, wear resistance.

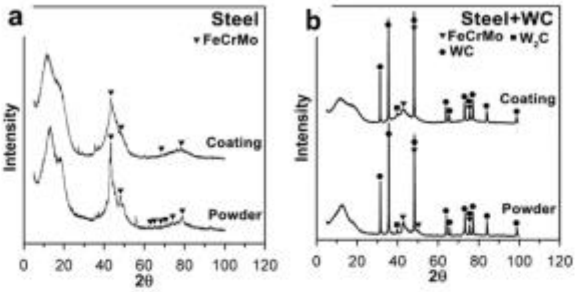

Figure 1: The XRD patterns for powder and coatings of (a) steel, and (b) steel+WC composite.

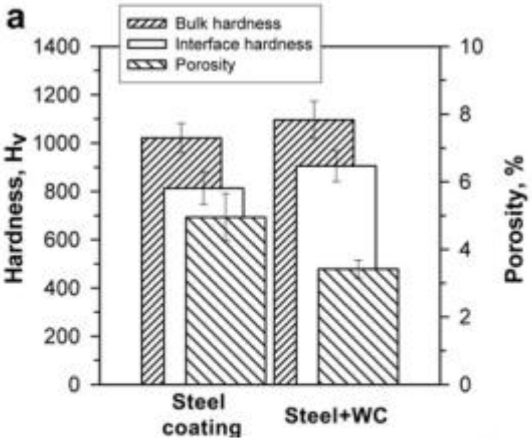

Figure 2: The hardness (bulk and interface) and porosity.

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Bacteria-Responsive Gold Nanoclusters-Mesoporous Silica-Polymer Mixed Membrane Coating: Simultaneous Detection and Inhibition of Healthcare-Associated Infections

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Abstract:

Healthcare-associated infections affect patients receiving treatments in a medical facility, bacterial infections being the most common.[1] Prototypes of coating materials for medical devices incorporating antibacterial agents have been designed, but the leaching of active agents and their poor dispersion rema in a major concern.[2] Herein, we fabricated a smart antibacterial mixed-membrane coating comprising gold nanoclusters@lysozyme colloids gating mesoporous silica nanoparticles loaded with antimicrobial agents, together acting as nanofillers in a polymer coating material.The nanofiller was dispersed homogenously within the polymer matrix without phase separation and particle leaching. The process could be easily scaled-up with excellent uniformity. The particles were shown to be bacteria-responsive for the controlled release of antimicrobial agents and the mixed-matrix coating successfully inhibited the bacterial contamination. A radiographic dental imaging device prone to oral bacterial contamination was then coated with the antimicrobial material. The device performance remained unchanged with a drastic decrease of bacterial contamination which promises further applications on various medical devices without compromising their utility.

Keywords: gold nanoclusters; controlled release; mesoporous silica nanoparticles; antibacterial surfaces; mixed matrix membranes.

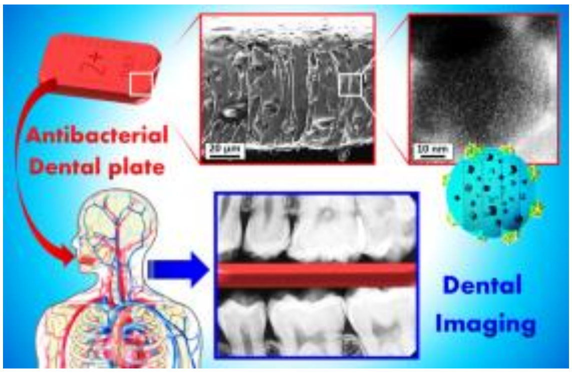

Figure 1: Figure illustrating the coating of an X-ray dental plate device with smart bacteria-responsive coating.

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A study of wear performance and Lubrication mechanism of WC-10Co-4Cr HVOF sprayed coating under engine oil and graphitic nanoplatelets

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Abstract:
Degradation by different types of wear has been the major problem in various engineering applications in which different parts operate in severe and drastic conditions e.g. high temperature, moisture and humidity, environmental instability etc. Therefore WC-Co-Cr HVOF based thermal spray coatings are deployed in a multi range of applications to give extension and long life to components by retarding their wear and corrosion.

This study compares the wear rate of the coated sample at 30N and sliding velocity of 25m/s with Pin on disk tribometer. These coatings showed high wear rate under engine oil lubricant, graphene nanoplatelets containing ethanol solution and graphitic nanoplatelets as an additive in engine oil. The experimental results showed the remarkable change in the decarburisation of WC under different lubrication conditions. The investigated sample were examined by means of SEM, stereo and light microscope before and after exposure to wear tests. Based on the experimental results it was demonstrated that coatings exhibit optimal wear rate when exposed to different conditions. Thus, giving us the best properties of hardness, fracture toughness.

Keywords: High velocity oxy-fuel; WC-Co-Cr coatings; Wear rate; Engine oil; Nano-additive engine oil; Lubricating mechanism; Graphitic nanoplatelets.

Laser Inscription of Pseudorandom Structures for Microphotonic Diffuser Applications

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[2] Shaqra University, Department of Mechanical Engineering, School of Engineering, Dawadmi, Saudi Arabia

Abstract:

Optical diffusers provide a solution for a variety of applications requiring a Gaussian intensity distribution including imaging systems, biomedical optics, and aerospace. Advances in laser ablation processes has allowed rapidly producing efficient optical diffusers. Here, we demonstrate a technique to fabricate high-quality glass optical diffusers using a continuous CO2 laser. Surface relief pseudorandom microstructures were patterned on both sides of the glass substrates. A numerical simulation of the temperature distribution showed that the CO2 laser drills a 137 µm hole in the glass for every 2 ms of processing time. The FFT simulation was utilized to design predictable optical diffusers. The pseudorandom microstructures were characterized with optical microscopy, Raman spectroscopy, and angle-resolved spectroscopy to assess their chemical properties, optical scattering, transmittance, and polarization. Increasing laser exposures and the number of the diffusing surfaces enhanced the diffusion and homogenized the incident light. . The recorded speckle pattern showed high contrast with sharp bright spot free diffusion at the far field view range (250 mm). A model of glass surface peeling was also developed to prevent its occurrence during the fabrication process. The demonstrated method provides an economical approach in fabricating optical glass diffusers in a controlled and predictable manner. The produced optical diffusers have application in fibre optics, LED systems, and spotlights.

Keywords: Optical diffusers, CO_2 laser ablation, Glass patterning, speckle patterns

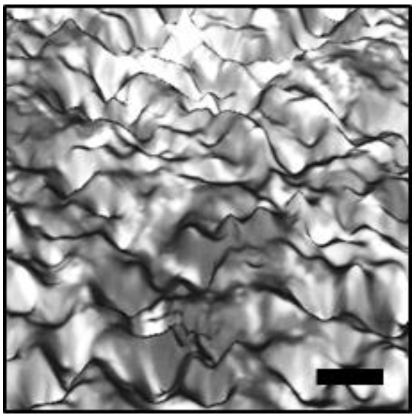

Figure 1: The 3D optical microscope images of pseudorandom microstructures on float glass substrate (Scale bar = 100 µm).

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Fe Nanoparticles in CuAl Alloy Matrix Systems

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[2] Department of Physics and Astronomy, Leicester University, Leicester, UK
[3] Department of Physics, Warwick University, Coventry, UK

Abstract:

The samples were made in the form of thin films by the flexible LECBD technique [1], therefore allowing a high degree of control over the nanostructure of materials. The effect of atomic structure changes in the Fe nanoparticles on the atomic moment of the Fe nanoparticles will be discussed.

Fe K edge and Cu K edge EXAFS experiments were performed to investigate the atomic structure in the samples. The EXAFS experiments were carried out on beamline B18 at the Diamond Light Source. The measured spectra were background subtracted and normalized using the program PySpline [2] to provide the EXAFS spectra $\chi(k)$. These could then be analysed to obtain structural parameters such as interatomic distances r_i, mean square variations in interatomic distance σ_i^2 (Debye–Waller factors) and coordinations N_i. The EXCURV98 program [3] was used for the analysis, which uses fast curve wave theory [4] to calculate $\chi(k)$. Atomic scattering potentials and phase shifts are calculated within the program using Hedin–Lundqvist potentials, which account for the amplitude reduction effects in EXAFS [5].

Cu K edge EXAFS were performed for Fe nanoparticles embedded in CuAl alloy matrices with varried Al-contents. There is a slight stretch in the Cu-Cu interatomic distances, while the face centred structure in the $Cu_{1-x}Al_x$ matrix is maintained, as the Al-content in the alloy matrix is increased.

Fe K edge EXAFS were performed for Fe nanoparticles embedded in CuAl alloy matrices with varried Al-contents as well. For Fe nanoparticles in CuAl alloy matrix samples with low Al-content both bcc and fcc structures were observed in the Fe structure. As the Al-content in the matrix increases to higher values, the atomic structure of the embedded Fe nanoparticles changes predominantly to bcc.

The atomic moment in the Fe nanoparticles initially increases rapidly as the Al-content in the $Cu_{1-x}Al_x$ matrix is increased. The strong increase in atomic Fe moment with increasing Al-content seen here is therefore consistent with an increasing proportion of bcc Fe nanoparticles. For Al-contents higher than 0.13 in the $Cu_{1-x}Al_x$ alloy matrix, the net atomic moment value of Fe decreases slightly due to the high degree of alloying between Fe and Al atoms in a sample.

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Nanotech ME 2017 / Surtech ME 2017
Session II:

Nanomaterials for Energy and Environment / Nano Electronics

Underwater Robotic Manufacturing by Biomimetic Macroscale Assembly

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Abstract:
This project supports one of the Abu Dhabi Economic Vision pillars in "sufficient and resilient infrastructure capable of supporting anticipated economic growth", by addressing the research challenge of effective, affordable, robust, safe and environmentally friendly manufacture, maintenance and repair by construction in the special underwater coastal environments. Such economically pertinent infrastructure includes offshore oil/gas platforms, power plants and pipelines, electric and communication cables, ultrafast vacuum-pipe transporter networks (e.g. *Hyperloop*), ports and coastal or floating residences, and defense technology among others. Such construction operations underwater are critically limited by the availability, cost, safety and health hazards of specialized welder/inspector-divers [1]; while traditional robotic approaches using *remotely operated* (ROV) or *unmanned autonomous* (UAV) *vehicles* and manufacturing arms entail complex, sensitive and expensive technology for slow serial, fault-prone transport and assembly operations. Therefore, the research of this project introduces, investigates and demonstrates a novel and transformative robotic platform of self-propelling, self-navigating and self-joining swarms of parts, synergistically self-assembling into a designed structure in microgravity marine environments. This research thus enables unmanned, robust, time- and cost-efficient parallel manufacture and environmentally conscious infrastructure development [2,3]. At the same time, the project combines research with university and K-12 education, outreach to the public and training of UAE human resources, partnership with national laboratory and industry with international centers, and startup innovation for commercialization of its technologies.

Keywords: underwater manufacturing, biomimetic robotics, unmanned autonomous vehicles, self-assembly, nanoheaters

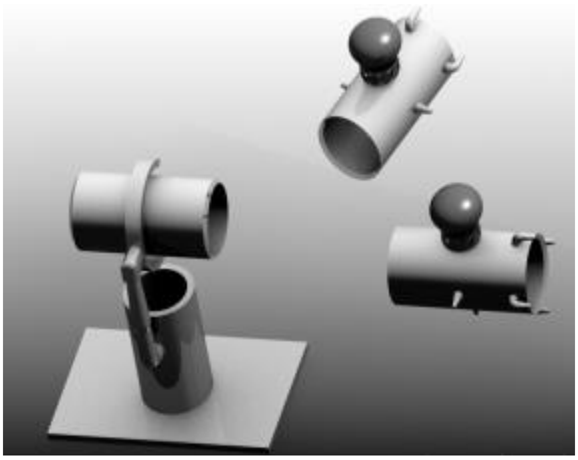

Figure 1: Underwater self-assembly [4] of self-propelling, self-navigating and self-heated joining components of a structure.

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One-dimensional nanoworld for energy applications

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Abstract

Making it small is a technological edict that has changed the world. Nano engineered material system is a rapidly evolving area of science and engineering that holds the promise of creating new techniques to manufacture devices and develop advanced technology. It is fundamentally changing the way materials and devices will be produced and it will be central to the next era.

My research group is interested in developing variety of engineered/advanced nanomaterial systems for energy applications. It is our group objective to control nanometer-scale features to enhance material properties and device functions beyond those that we currently know. During my presentation, two areas of ongoing research will be presented: (i) $LiFePO_4$ nanowire-based Li-ion battery for space applications, (ii) CIGS nanowire-based solar cell.

Towards a discovery solution for nanotechnology – Challenges & Prospects

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Abstract:

The exponential growth in nanotechnology has led to vast amounts of information and data being dispersed throughout various journals and patents making the acquisition of this information difficult. Furthermore, the lack of standardized nomenclature for nanomaterials is a huge challenge which makes seeking and transfer of scientific results a difficult task for researchers. There exists, however, a great demand for quick and curated information on nanomaterials, properties and applications. nano.nature.com known as Nano1 was launched on 15 June 2016 as a non-journal type product under the Nature Research portfolio. It aims to provide highly indexed and structured information related to nanotechnology, including materials, properties, applications and preparation methods, derived from peer-reviewed journals at the article level and in manually curated nanomaterial summaries that compile data from multiple sources.

This talk will illustrate how Nano can aid nanotechnology research communities to obtain fast and precise insight into the wealth of nanotechnology based scholarly knowledge via use case scenarios and pro-vide the latest information for new discoveries and developments.

Keywords: nanotechnology research solution, precise data search, nanomaterials & nanodevices data

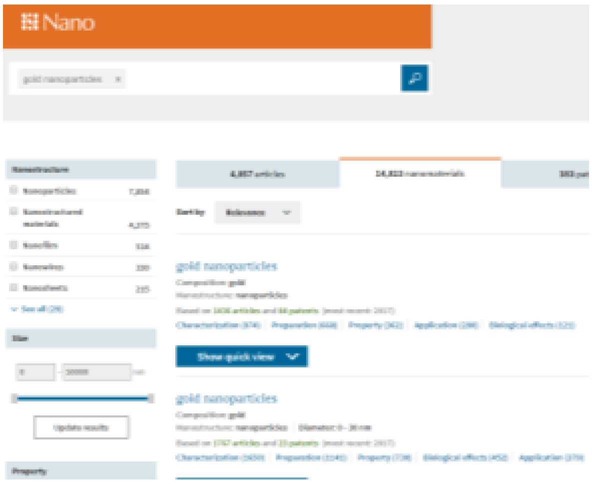

Figure 1: A preview of Nano.

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Nanotech ME 2017 Session II.A:

Nanomaterials for Energy and Environment

Towards Mechanistic Understanding of the Role of Nanoparticle Technology in Energy and the Environment Applications

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Abstract:

Nanoparticle technology is a promising field of interdisciplinary research, which opens up numerous opportunities in various fields in the energy and environment. Hence, potential uses and benefits of such technology are enormous. Our Nanotechnology Research Group at the University of Calgary has carried out a number of research activities pertaining to the synthesis and direct application of metal-based nanoparticles for enhanced oil upgrading and recovery (EOR), wastewater treatment, and H_2S and CO_2 capture. Methods for application of nanoparticle technology in heavy oil processing can be conveniently categorized as in-situ and ex-situ application. In-situ upgrading and recovery of heavy oil in reservoir, whereby nanoparticles are directly exposed to real heavy oil feed. Steam processing is one of the main in-situ application where nanoparticles play significant role in providing active reaction area for the molecules and increase the hydrogen production out of the steam, at specific pressure and temperature. Ex-situ applications resemble the on surface upgrading in which nanoparticles are incorporated and dispersed into support and consequently used in a packed-bed process using real heavy oil feed. In both cases, the presence of nanoparticles significantly enhanced the upgrading and recovery of heavy oil. For convectional oil recovery enhancement, nanoparticles could decrease the interfacial tension (IFT) and increase the contact area through the reservoir by improving of sweep efficiency. Other mechanisms by which nanoparticles improve the EOR performance include alteration of rock wettability, changes in permeability and reduction in oil viscosity and mobility ratio. In addition, adding nanoparticles to injecting fluid can also prevent formation damage as nanoparticles may serve as inhibitors for asphaltene precipitation. As for wastewater treatment, nanoparticles functionalized with a petroleum vacuum residue (VR) could be used successfully for removing oil from oil–saltwater emulsions at different ranges of pH values. As for H_2S and CO_2 capture, metal-based nanoparticles could capture sulphur and CO_2 and convert them into a chemically inactive mineral within the oil reservoir during the upgrading and/or recovery processes.

In this talk, we will show the recent findings obtained by our group pertaining to the use of in-house prepared metal-based nanoparticles for enhancing oil upgrading and recovery, wastewater remediation and H_2S and CO_2 capture. We believe our work in synthesis and application of nanoparticles will provide viable clean alternative technologies for enhancing oil recovery, wastewater treatment and CO_2 capture.

Carbon Nanomaterilas for Water Treatment Applications

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Abstract:

Removing different types of pollutants from water is of utmost importance to the world due to the severe shortage of fresh water resources. Industrial processes such as paper manufacturing, textile processing, food and beverage production, metal processing, and petrochemical refining produce enormous volumes of wastewater, which is a valuable resource of water once properly treated. Removal of contaminants and reuse of the treated water would provide an exceptional alternative. Widespread concern over the toxicity and the environmental impact of the ionic metals, cationic compounds and microorganisms have led to extensive research aiming to develop effective technologies for the removal of these potentially hazardous substances from effluents and industrial wastewater. In the presentation, the use of carbon nanomaterials (CNMs), member of the fullerene structural family, is considered with special focus on the removal of heavy metals from water (lead, chromium, cadmium, arsenic, copper, zinc and nickel). A critical review into the adsorption behavior and use of the CNMs is given with attention being paid to the effects of surface modifications on the adsorption behavior and subsequent heavy metal removal. A review of the effect of a number of key variables including pH, CNMs dosage, time, ionic strength, temperature and surface charge are given. It will be demonstrated that, surface modification enhances positively the adsorption capacity of CNMs towards cadmium, chromium, lead, mercury, copper, zinc, cobalt and nickel as did the solution pH. CNMs have been proven to an excellent adsorbent for the removal of different heavy metals from water. However, most of the applications of CNMs are on lab scale in batch experiments. In spite of high costs, CNMs are expected to be a promising adsorbent in the future due to its high adsorption capacity compared to many traditional adsorbents. Researchers are also in quest of novel environment friendly techniques for the surface modification of CNMs to further improve their properties.

Keywords: Carbon Nanomaterial, Water Treatment and Water Desalination

Pulsed Lasers based writing of Reconfigurable Nanopatterns

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Abstract:

Arrangements of nanostructures in well-defined patterns are the basis of photonic crystals, metamaterials and holograms. Furthermore, rewritable optical materials can be achieved by dynamically manipulating nanoassemblies. Here we demonstrate a mechanism to configure plasmonic nanoparticles (NPs) in polymer media using nanosecond laser pulses. The mechanism relies on optical forces produced by the interference of laser beams, which allow NPs to migrate to lower-energy configurations (Figure 1). The resulting NP arrangements are stable without any external energy source, but erasable and rewritable by additional recording pulses. We demonstrate reconfigurable optical elements including multilayer Bragg diffraction gratings, volumetric photonic crystals and lenses, as well as dynamic holograms of three-dimensional virtual objects. We aim to expand the applications of optical forces, which have been mostly restricted to optical tweezers. Holographic assemblies of nanoparticles will allow a new generation of programmable composites for tunable metamaterials, data storage devices, sensors and displays.

Keywords: Pulsed lasers, laser ablation, nanaoparticles, nanopatterns

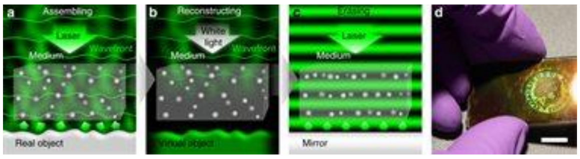

Figure 1: Figures (a-c) illustrate the movement of nanoparticles under the influence of optical forces. (d) The resulting 3D nano-assemblies act as holograms.

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Hydrothermal synthesis of manganese phosphate/graphene foam composite for electrochemical supercapacitor applications

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Abstract:
Metal phosphates or manganese phosphates have been extensively explored in high-performance solar cells, lithium batteries and rarely in SCs[1-3] Ma *et al* studied electrochemical performance of manganese phosphate with nanosheets structure in a three-electrode cell configuration, but using alkaline and neutral electrolytes and they reported a high specific capacitance of 203 F g^{-1} and 194 F g^{-1} at a current density of 0.5 A g^{-1} using 1 M Na_2SO_4 and 2 M KOH electrolytes respectively[4]. Generally, synthesis of manganese phosphates with different morphologies always remains very attractive due to their unique advantages, such as abundant active sites for reactions with fast interfacial transport of charge carriers by decreasing the diffusion path length through the structure, and also because phosphate has strong P-O covalent bonds which makes Mn3(PO4)2 structure chemically very stable.

Here we roprt on manganese phosphate ($Mn_3(PO_4)_2$ hexagonal micro-rods and ($Mn_3(PO_4)_2$ with different graphene foam (GF) mass loading up to 150 mg which were prepared by facile hydrothermal method. The characterization of the as-prepared samples proved the successful synthesis of $Mn_3(PO_4)_2$ hexagonal micro-rods and $Mn_3(PO_4)_2$/GF composites. It was observed that the specific capacitance of $Mn_3(PO_4)_2$/GF composites with different GF mass loading increases with mass loading up to 100 mg, and then decreases with increasing mass loading up to 150 mg. The specific capacitance of $Mn_3(PO_4)_2$/100 mg GF electrode was calculated to be 270 F g^{-1} as compared to 41 F g^{-1} of the pristine sample at a current density of 0.5 A g^{-1} in a three-electrode cell configuration using 6 M KOH. Furthermore, the electrochemical performance of the $Mn_3(PO_4)_2$/100 mg GF electrode was evaluated in a two-electrode asymmetric cell device where $Mn_3(PO_4)_2$/100 mg GF electrode was used as a positive electrode and activated carbon (AC) from coconut shell as a negative electrode. AC//$Mn_3(PO_4)_2$/100 mg GF asymmetric cell device was tested within the potential window of 0.0–1.4 V, and showed excellent cycling stability with 96% capacitance retention over 10 000 galvanostatic charge-discharge cycles at a current density of 2 A g^{-1}.

Keywords: Manganese phosphate, Activated carbon, Graphene foam, Hydrothermal method, Asymmetric supercapacitor, Energy storage.

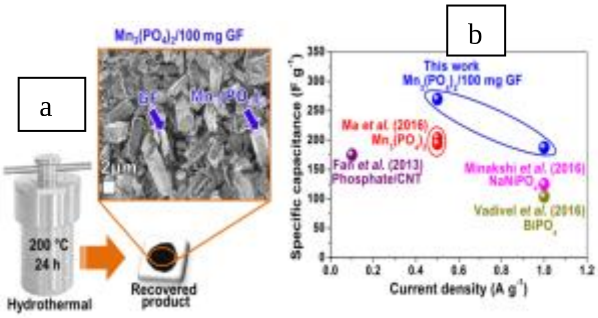

Figure 1:(a) Synthesis route of the material and showing the SEM images of the final product and (b) Comprarison of the specific capacitances as a function of cureent density

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Progress in Nanocrystal Zeolites of MFI for Hydrocarbon Cracking

Emad N. Al-Shafei [1*], Oki Muraza [2], Mohammed A. Sanhoob [2], Anas K. Jamil [2], Ki-Hyouk Choi [1],
Mohamed A. Abdullah [1], and Ali S. Alnaser [1]

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Abstract:
Structured zeolites are the potential catalysts for the refinery and petrochemical industry applications. There are several challenges that limited utilizing zeolites due to catalyst stability and high coke formation. The study aims to develop nano crystal zeolite for the hydrocarbon conversion with better hydrothermal stability [1]. In order to overcome these intrinsic limitations, zeolite crystal size was reduced to the nanoscale to shorten the diffusion path length to improve the accessibility of molecules and to accelerate the reaction rate. On the other hand, this vulnerability of zeolite framework toward hydrothermal treatments in steam can open new doors to effectively modify and even to synthesize new zeolites [2]. The study explored the effect of synthesis parameters on the catalyst activity and the hydrothermal stability of nanoscale MFI zeolites of nano size one-dimensional and three-dimensional pores pf zeolite ZSM-22 and ZSM-5 (Figure 1). The hydrocarbon cracking catalytic was carried out by using fixed bed to improve the conversion, reaction selectivity, catalytic stream stability (Figure 2) and coking rate with an emphasis the role of nanostructure zeolite. Also, the presentation will discuss the reaction mechanism of shape selectivity of nanocrystal zeolites at moderate temperature and effect of steam addition to the zeolite stability.

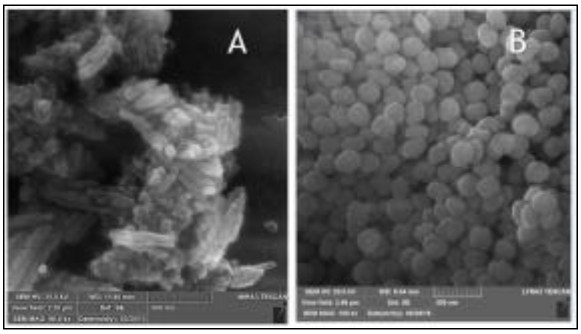

Figure 1. Nanocrystals of MFI zeolite of ZSM-22 (A) and ZSM-5 (B)

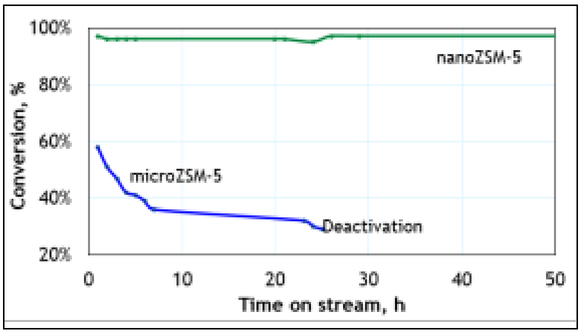

Figure 2. Catalytic activity test of hydrocarbon conversion

Keywords: MFI, ZSM-5, ZSM-22, nanocrystal, zeolite, hydrocarbon cracking.

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Microwave-assisted synthesis of cobalt sulphide nanoparticles clusters on activated graphene foam for electrochemical supercapacitor

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Abstract:

Transition metal chalcogenides such as cobalt sulphide [1-2], molybdenum disulphide [3], nickel sulphide [4]., and copper sulphide [5] are potential electrode materials for supercapacitor applications because they are known to be electrochemically active. However, cobalt sulphide which exists in different stoichiometric ratios like $Co_{1-x}S$, CoS, CoS_2, Co_9S_8, and Co_3S_4, is considered to be a suitable candidate for electrochemical supercapacitor applications due to its good electrochemical activity, high thermal conductivity, and low cost compared to other metal sulphides. Amongst different cobalt sulphide stoichiometries, Co_9S_8 is a typical transitional metal chalcogenide which has great potential in battery and supercapacitor application [6]. However, the poor electrical conductivity and mechanical instability of Co_9S_8 limit its energy storage application. In order to improve the properties of Co_9S_8, its various nanostructures have been investigated, for example, 3D flower-like, nanoflakes, nanotubes and rose-like structures [7]. It has been established that modifying the Co_9S_8 with carbon materials by preparing Co_9S_8/carbon composites is one of the most effective strategies to increase the electrical conductivity as well as the electrochemical properties of Co_9S_8. Carbon materials provide interconnecting mesostructured supports that can facilitate good nanoparticle dispersion and electron transport. For example, Rajendran *et al.* have produced Co_9S_8 nanoflakes on graphene to form Co_9S_8/G nanocomposites, for high-performance supercapacitors [8]. So far no work has been done on the microwave-assisted hydrothermal synthesis of Co_9S_8 nanoparticles clusters on activated graphene foam (AGF) derived from polymer-based materials in an aqueous electrolyte media for electrochemical supercapacitor application.

Herein, we report a microwave-assisted hydrothermal synthesis of Co_9S_8 nanoparticles clusters on a porous sheet-like AGF derived from polymer-based materials in an aqueous electrolyte media. Microwave-assisted hydrothermal synthesis is a promising preparation method since the microwave synthesis process consists of high reaction rate and fast heating, and is capable of reducing reaction time drastically and saving energy thus lowering the cost of final product. In addition, microwave-assisted hydrothermal synthesis also has many other unique advantages, such as the homogeneous volumetric heating, the high penetration depth of microwave, and high selectivity. We also explore the potential of the composite as an electrode for supercapacitor applications. An electrochemical performance of as-prepared Co_9S_8 and Co_9S_8/AGF electrodes was evaluated in a three-electrode cell configuration using 6 M KOH. The specific capacitance of Co_9S_8/AGF electrode was obtained as 1150 F g^{-1} and that of the Co_9S_8 electrode as 507 F g^{-1} at a scan rate of 5 mV s^{-1}. Co_9S_8/AGF electrode showed a good cycling stability with 94% capacitance retention over 1000 charge-discharge cycles.

Keywords: Co_9S_8/AGF; Cobalt-sulphide nanocomposite; Activated graphene foam, High specific capacitance; Good cycle stability, Energy storage

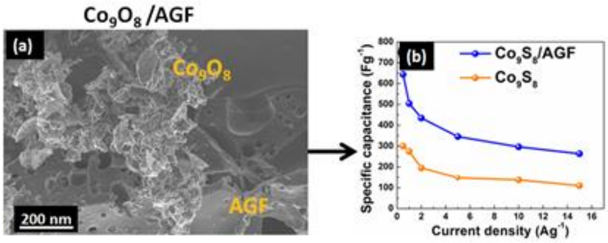

Figure 1:(a) SEM images of the as-prepared Co_9S_8/AGF sample at low and high magnifications respectively (b) Specific capacitances of Co_9S_8 and Co_9S_8/AGF electrodes as a function of current density

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Nanotechnology of Pinning Centres in Superconducting Films for Clean Energy-saving Power Applications

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Abstract:
Energy resources are now a major issue in the global economy, while climate changes due to increasing CO_2 emissions are now obvious. In these circumstances, a large number of devices and equipment with increased energy efficiency and more environmentally-friendly, based on advanced superconducting materials, will start, gradually, to replace the existing "classical" devices and equipment. Even now, a large number of magneto-superconducting equipment cooled below liquid nitrogen temperature proved to be highly energy efficient (50% less consumption) and environmentally-friendly and with a longer lifetime compared with their copper-based counterparts: magnetic billet heaters for non-ferrous metallurgy, superconducting-magnetic energy storage, fault current limiters, superconducting electric engines for ship propulsion and wind turbines, transformers, superconducting cables for large currents, etc.. From economics point of view, larger market penetration of cryo-electromagnetic devices fabricated from superconducting bulk/wires/tapes) depends on the cost, expressed in Euro/kA·m, hence, the price reduction can be achieved by increasing the critical current I_c (maximum current that can be transported without losses). High magnetic fields strongly reduce critical current density due to the dissipation caused by the movement of flux lines (Lorentz force, thermally-activated flux creep). The above-mentioned dissipation can be minimized by artificial defects (nanostructuring) that could fix (pin) the magnetic flux lines due to the decrease in the free energy if the flux line "sit" on the defect. In the case of $YBa_2Cu_3O_x$ high-temperature superconducting films, nanotechnology of pinning centres involves several approaches: substrate decoration [1], quasi-multilayers [2], targets with secondary phase nanoinclusions [3], and combinations of the above mentioned [4], involving various architectures and nanoinclusions. We will present results from DC magnetization loops, magnetic relaxation, AC susceptibility and TEM images and discuss the improvements in critical current for various nano-architecture. The difference between correlated and synergetic pinning centres are also very important and will be pointed out.

Keywords: energy-efficient materials and devices, superconducting materials, critical current, nano-scale pinning centres.

Acknowledgement: Financial support from Romanian Ministry of Research and Innovation through POC (European Regional Development Fund) Project P-37_697 nr. 28/01.09.2016 is gratefully acknowledged.

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Novel rGO/CdS encapsulated SNC for improved Oxygen Reduction reaction

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Abstract:

Alkaline and acidic fuel cells, hydrogen production, metal air batteries and water splitting have been renowned as clean energy strategies due to their high efficiency and environment friendly. In these devices, Oxygen Reduction reactions (ORR) is playing a major role. Platinum (Pt/C)-based electro-catalysts are the most promising and practical fuel cell catalysts[1] but their production cost and material reliability is high. Therefore, inorder to become commercially viable, the search of other reliable electrocatalysts is one of the most robust and modest research in electrochemistry. Since, the earlier studies have shown the ORR and OER reaction pathway is highly dependent on electrode materials and reaction media[2]. One main aim in electrocatalytic research is to develop an efficient, facile and low cost with highly active, low emissions and highly durable catalysts for Oxygen (O_2) reduction reaction (ORR) and Oxygen evolution reaction (OER) In this vision, herein at first time, we report the facile, cost effective and a rational design and fabrication of rGO@CdS attached Tris (bipyridine) ruthenium (II) chloride ($[Ru(bpy)_3]^{2+}$/Perylene) metal organic Silica nano-capsules for electrocatalytic ORR and OER applications. In order to enhance the electrocatalytic activity the rGO (reducded graphene oxides) quantity has been varied (ie. 1 wt%, 2 wt% and 3 wt%). Surface morphologies of the prepared samples were confirmd by Microscopic analyses, **Fig 1a** show the FE-SEM image of 2wt% rGO/CdS/SNC. Finally, during ORR reaction, the 2 wt% rGO/CdS/SNC showed an excellent electrocatalytic activity and highly durable activity than other samples as shown in **Fig 1b**. The preliminary results reported here will shed new light on the future design and applications of multifunctional platforms for energy harvesting.

Keywords: electrocatalyst, oxygen reduction reaction, CdS, reduced graphene oxide, Ruthenium complex, Silica coreshell.

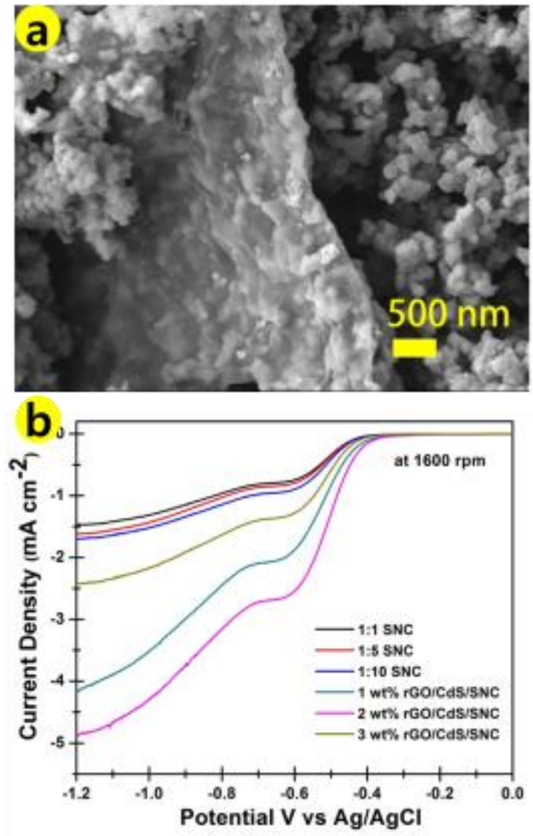

Figure 1: (a) FE-SEM image of 2wt % rGO/CdS attached SNC and (b) Compared ORR activity of prepared samples under O_2 saturated 0.1M KOH at 1600 rpm.

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Sustainable Valorization of Carbon Dioxide towards Methane with Ionic Liquids Nanoparticles

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Abstract:

Carbon dioxide emissions resulting from the consumption of carbon-based fossil fuels is generally accepted as the cause of global warming. As worldwide fossil-fuel consumption has an increasing trend, thus carbon emissions will be increased, from their current level already above 30Gt/year. Carbon capture and sequestration is currently under scrutiny at large pilot-plant level as a mitigation strategy for the CO_2 emission problem and global warming. Carbon dioxide utilization has also been proposed, but the sheer size of carbon emissions imposes that only the transformation of CO_2 into fuels may have any real potential as an alternative to sequestration. Carbon dioxide use and utilization, CCU, aims at transformation of carbon dioxide into valuable products (Figure 1) [1].

Here we report hydrogenation of carbon dioxide towards fuels, namely methane in ionic liquid media using catalytic ionic liquids based nanoparticles. Methane gas generated from the process can be added to the gas grid, produce electricity, heat buildings, or power garbage trucks. The important role of ruthenium nanoparticles prepared in situ to catalyse the reaction at moderate conditions of temperature and pressure must be highlighted to produce methane selectively and efficiently.

We developed a CO_2 hydrogenation process to methane in imidazolium-based ionic liquid media, using ruthenium nanoparticles prepared in situ as catalyst system [2]. The best yield of methane (69%) was achieved using 0.24 mol% ruthenium catalyst (in [omim][NTf2], 1-octyl-3-methylimidazolium bistrifluoromethanesulfonylimide, at 40 bar of hydrogen pressure plus 40 bar of CO_2 pressure, and at 150°C.

Keywords: nanoparticles, carbon dioxide, nanotechnology, fuels, sustainable chemistry, energy.

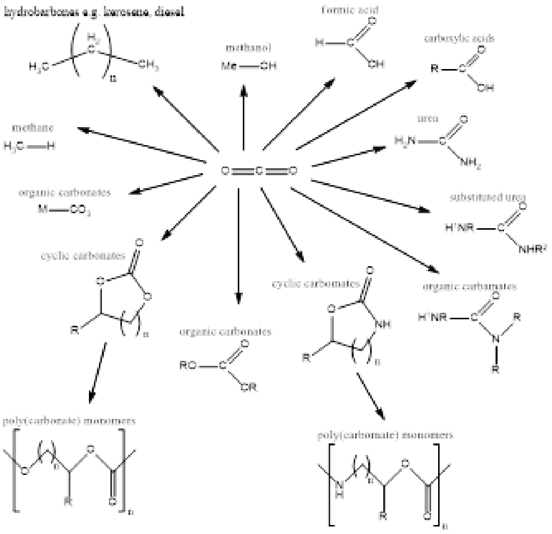

Figure 1: Figure illustrating the Valuable products from Carbon Dioxide Utilization [1].

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Nanotech ME 2017 Session II.B:
NanoElectronics

Design, Fabrication and Characterization of III-nitride high speed photonic sensors

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Abstract:

III-Nitride semi-conductor materials have attracted a lot of interest for new generation of optoelectronic devices. The advantage with these materials is the flexible bandgap varying from 0.7 to 6 eV hence covering an ultra-broad spectrum, from deep ultraviolet up to near infrared, allowing the development of numerous applications. Solar cells based on nitride materials have been investigated for terrestrial and space-based applications. Transistors performance for high power electronics, ground-based communications and biological agent detection devices have been enhanced. Major efforts have been dedicated to the technological fabrication in order to achieve efficient emitters and detectors. Recent progress has demonstrated cutting-edge results in high-speed data rate connectivity and integrated circuits. Imaging sensors based on high speed electronics have been implemented based on their sensitive applications in security screening. Gallium nitride (GaN) as a member of III-nitride family has become the revolutionary material owing to its electronic and optical properties [1-2]. Direct, flexible and wide bandgap of GaN makes this materiel a key candidate for achieving high frequency, bandwidth, power and efficiency devices. GaN based detectors are in particular suitable for full color display, high density information storage, and UV-VIS communication links. In this study, design, material characterization and device fabrication have been performed for InGaN/GaN based photodiodes. The InGaN absorbent layer has been defined with indium content of 10%. The objective of this work has been directed towards fabrication of high speed photodiodes. The first step of this work is to optimize the photodiode design and fabrication in order to reduce the capacitive effects [3]. Firstly, large-scale photodiodes have been used to extract the photocurrent and the cut-off frequency. The increase of photocurrents is observed once the laser power is increased and attains 1.2 mA equivalent to 12 A/cm² with EQE value of 13 %. Theoretical frequency calculations of the photodiode have been performed in order to compare it with the experimented values issued from C-V setup and Noise measurement. Results demonstrate a cut-off frequency at -3dB of 300 MHz using noise measurement for 100×100 µm^2 photodiode. The evaluation of optical device performance paves the way to higher frequency for device dimensions up to 20µm.This study offers the possibility to work toward InGaN-based micro-photodiodes with a perspective for photonic sensors.

Keywords: III-nitride semiconductors, high speed devices devices, design, technological fabrication, optical properties, sensors application

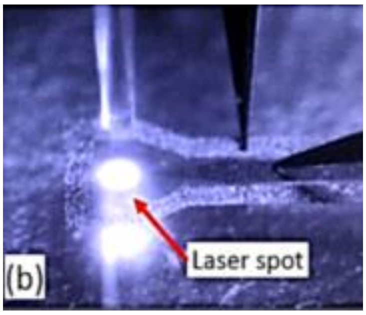

Figure 1: illustrating Image from super-zoom HD camera showing InGaN/GaN semiconductors based micro photodiode under blue illumination.

References:

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Design and Properties of Heterostructured Nanoparticles based on modified potassium polytitanates

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Abstract:
Nanoscale particles of different metal, dielectric and semiconductor particles represent a base for modern nanoelectronics. New hybrid structures which are characterized with a presence of different heterojanctions provide a valuable tool to create novel functionalities via the synergetic combination of preexisting properties of several structural components [1].This study presents the results on synthesis and investigation of nanocomposite particles produced by the treatment of platy quasi-amorphous layered potassium polytitanate (PPT) in aqueous solutions containing different transition metal ions (Me^{n+}). The final product was represented by heterostructured semiconducting nanopowders consisted of platy PPT nanoparticles intercalated with Me^{n+} (doping) and/or decorated by Me_xO_y nanoparticles (multiple p-n junctions) (Figure 1). It was recognized that the obtained heterostructures based on coupling of different nanoparticles possess regulated energy levels for their corresponding conduction and valence bands. This structure provides an approach to achieve an efficient charge separation, an increased lifetime of the charge carriers as well as enhanced interfacial charge transfer and polarizibility. Electic conductivity of such compacted nanopwders varies in the range of 10^{-3}–10^{-10} S/cm whereas permittivity has values from 10^3 up to 10^9. Taking into account that transition metal ions usually show remarkable diversity in terms of the oxidation state and local crystal structure, the properties of such nanomaterials could be tailored by controlling with the conditions of synthesis. The recommendations on design, synthesis and application of new kinds of nanocomposite materials combining the properties of solid state electrolites, semiconductors and ferroelectrics are considered.

Keywords: potassium polytitanate, heterostructured nanoparticles, electron structure, physical properties, nanoelectronis, photovaltaics.

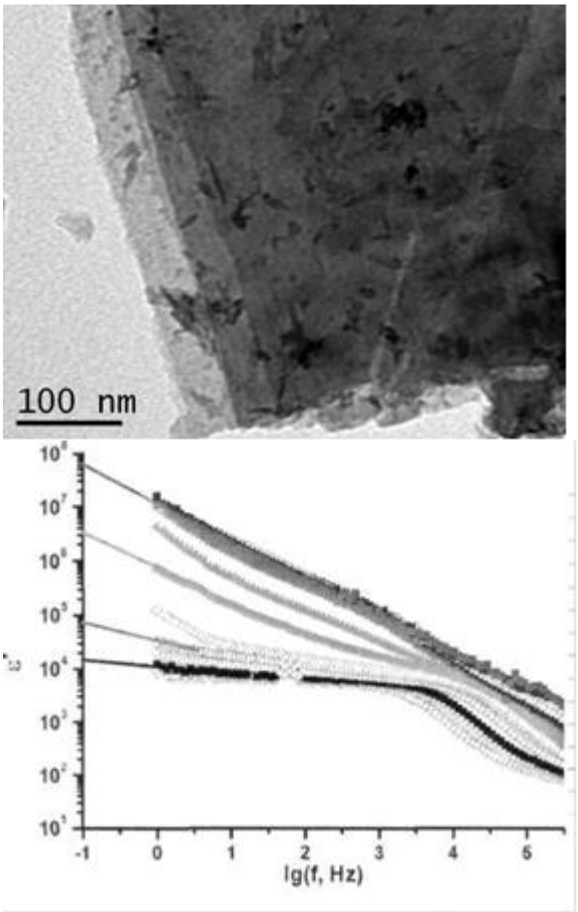

Figure 1: Figure illustrating the structure of nanocomposite particles (modified potassium polytitanate) and electrical properties of their compacted specimens of different composition.

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Flexible Superhydrophobic Electrochromic Devices

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Abstract:
We present a thin film electrochromic device fabricated by using PEDOT:PSS and Graphene as the active conductive electrode films and a flexible compliant polyurethane substrate with 1-ethyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide (EMI-TSFI) additive as the intermediate ionic medium. This low powered device with a compliant, elastic intermediate substrate along with controlled tuning in transparency of PEDOT:PSS provides a wide color contrast. We have also harnessed the wrinkling instability of graphene to achieve a hydrophobic nature yet, not compromising on transparency at the same time. This mechanical self-assembly approach helps in controlling the wavelength of wrinkles generated by inducing measured pre-strain conditions and regulating the modulus contrast by selection of materials used, hereby controlling the extent of translucence. The response times were analyzed to be 1.63 s and 3.15 s for a 2% increase and decrease in transmittance values respectively at an operating DC voltage of 15 V. Strain dependent studies show that the performance was robust with the device retaining switching contrasts even at 15% uniaxial strain conditions. Our device also exhibited superior antiwetting properties with an average graphene contact angle of 110° at an induced biaxial pre-strain of 30%. A wide range color contrast, tunable transparency and wetting nature of the device envision its application in smart windows, visors and other wearable equipment where flexibility is required for enhanced performance of the devices.

Keywords: wrinkling, electrochromism, elastic thin films, transparency, hydrophobic surfaces.

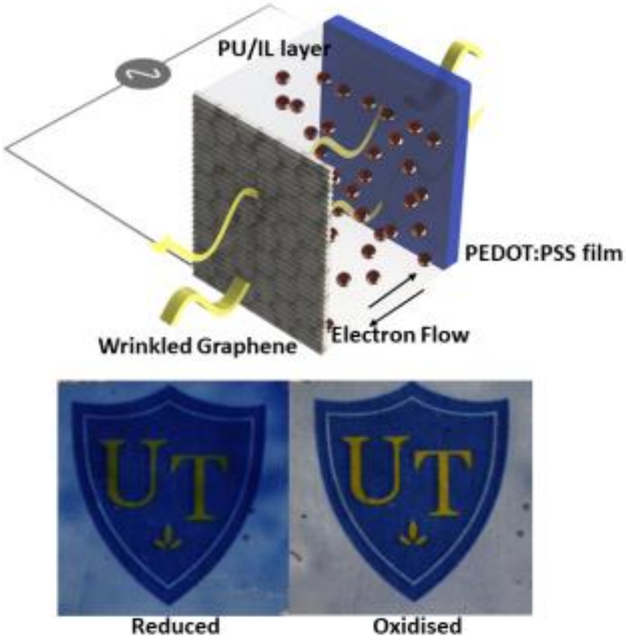

Figure 1: **Top:** A schematic diagram of the electrochromic device. **Bottom:** Reduced and Oxidized states of the device at an induced charge of 15V.

References:

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Novel Light Emitting Materials Based on Low Dimensional Perovskites

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Abstract:

Low-dimensional perovskites (perovskite quantum dots and zero-dimensional perovskites) are a new class of materials that possess excellent luminescence properties: tunable emission in the entire visible region (450-700 nm), narrow full width at half maximum (FWHM), high photoluminescense quantum yield (PLQY) and chemical robustness [1-3]. They are appealing for industrial applications, especially in optoelectronics (displays, light emitting diodes, white lighting) and are considered as a best alternative for highly toxic CdSe based quantum dots. In this study we report our latest advances on development of low dimensional perovskites.

Perovskite quantum dots (QDs) are nanoparticles with diameters in the range of 2-12 nm. In our lab, highly stable perovskite quantum dots $CsPbX_3$, where X is Cl, Br or I, have been developed. Our development efforts were focused on the surface modification of these nanoparticles to make them air-stable for optoelectronic applications. Perovskite QDs with high PLQY up to 95 %, narrow FWHM < 20-35 % and stability of several months at ambient conditions have been achieved using our method (Fig.1).

Zero-dimensional (Zero-D) perovskite Cs_4PbBr_6 is a new type of luminescent material with emission center at 516 nm that has high photoluminescence (PLQY > 70 %), outstandingly narrow emission peaks (FWHM < 20 nm) and exceptional stability (Fig.2).

We report here the application of low dimensional perovskites in different optoelectronic devices: LCD displays, light emitting diodes and white lighting. With further development, we expect these luminescent materials to play an important role in advanced optoelectronic applications.

Keywords: quantum dots, perovskite, nanoparticles, luminescence, optoelectronics, display, LED, lighting.

Figure 1: Photo of perovskite quantum dots ($CsPbX_3$, where X is Cl, Br or I) under UV light.

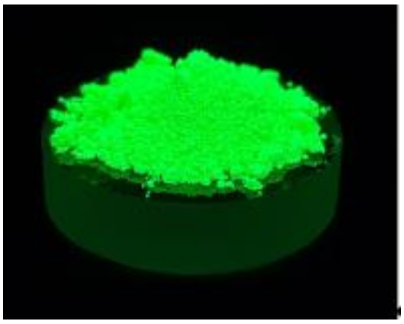

Figure 2: Photo of zero-dimensional perovskite Cs_4PbBr_6 under UV light.

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Effects of pressure and magnetic field on a two-dimensional Heisenberg antiferromagnet.

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Abstract:
In the search of new options for advanced spintronics devices, antiferromagnets are intuitively an alternative to the ferromagnetic systems. The latter can be easily manipulated by application of an external magnetic field, which, defining a preferential orientation, allow the construction of basic magnetic information units, extensively applied today, for instance, in credit cards and harddisks. Nevertheless, approaching a moderate magnetic field, all the information will be lost. Antiferromagnetic memories are appealing, since offer an alternative to ferromagnets. We are far from proposing a well-established solution but the difficulty of manipulating an antiferromagnetic arrangement preludes a significantly more stable solution against electromagnetic perturbations. Within this completely new research field, we focused our attention on a two-dimentional S = ½ quantum antiferromagnet [1]. The Heisenberg antiferromagnets resulting from arranging spins on a square lattice are intriguing low-dimensional spin systems, that show remarkable analogies with the copper-oxide high-T_c superconductors. $Cu(pz)_2(ClO_4)_2$ [2], a typical representative of these 2D systems, exhibits a very weak interlayer coupling [3] and is strongly influenced by external magnetic fields or hydrostatic pressure, leading to quantum phase transitions [4]. To explore its [T, p, H] phase diagram (up to 12 kbar and 7.1 T) we carried out magnetometry and ^{35}Cl nuclear magnetic resonance experiments. The magnetic field enhances the effective anisotropy, resulting in a positive shift of the Heisenberg-to-XY crossover temperature, whereas hydrostatic pressure reduces the ordering temperature [dTN/dp = –0.050(8) K/kbar], attributable to an angular deformation of the square lattice and the consequent increase of in-plane frustration. Complementary data on triangular and hexagonal lattices are considered in order to highlight the role of the geometry/topology on the magnetic structure. Finally, Monte Carlo simulations indicate that the antiferromagnetic order prevents the experimental accessibility of the renowned Berezinskii-Kosterlitz-Thouless (BKT) topological transition [5], expected to occur in the disordered XY phase.

Keywords: two-dimensional magnets, antiferromagnetism, topological transitions, advanced spintronics, nuclear magnetic resonance, magnetic field, hydrostatic pressure.

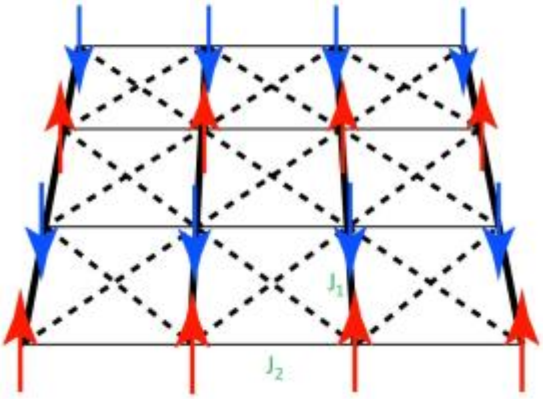

Figure 1: Figure illustrating the configuration of a (stripy) antiferromagnet on a quasi-square lattice. In our case, the square lattice is defined by the positions of the Cu atoms. J_1 and J_2 are the in-plane exchange interations.

References:

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High aspect ratio micro and nanostructures enabled by photo-electrochemical etching for sensing and energy harvesting applications.

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Abstract:

Micro- and nano scale pillars and holes with high aspect ratios for optoelectronic devices and sesnors can be fabricated by deep reactive ion etching (DRIE) or inductively coupled plasma (ICP) RIE. However, dry etching induced damages to the sidewalls and the surfaces lead to the formation of dangling bonds, surface traps, carrier leakage paths and recombination sites. Photoelectrochemical (PEC) etching can offer high anisotropy and selectivity while protecting the devices from damages on the sidewalls and surfaces.

We demonstrate an optical system based on long wavelength (980nm) infra-red (IR) illumination with high optical power laser (8-10 W) for controlled PEC etching process. (Figure 1). By patterning a silicon wafer surface with shallow structures and illuminating the wafer from the backside, PEC etching can result in high aspect ratio structures with minimal suface damages. Different factors influencing the PEC etching process such as photogenerated carriers, light intensities, electrolye concentration and doping concentration will be presented.

The development of controlled wet PEC etching process can be applied to several semiconcuctors commonly used in designing optelectronic devices, sensors and energy harvesting devices. Silicon is inherently weak in handling harsh environments including high temperatures, high voltages or high radiation. Our work focuses on using our understanding of silicon PEC etching as the guiding rules to determine and optimize the parameters for PEC etching of wide bandgap materials such as SiC, Ga_2O_3 and GaN.

Keywords: silicon, DRIE, PEC etching, surface damage effects, opto/electronic devices.

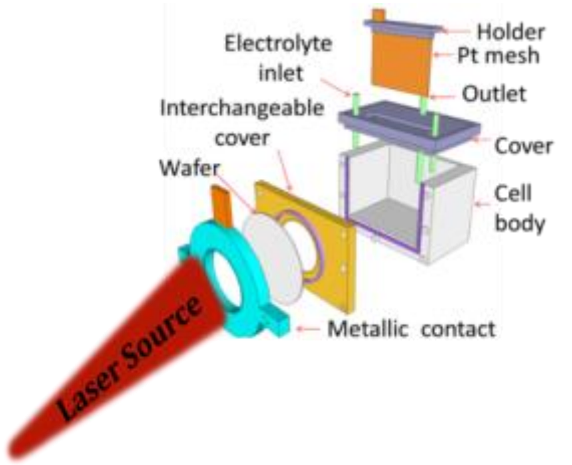

Figure 1: Schematics of a back-side iluminated electrochemcial etching (BIEE) setup. A high power laser illuminates the wafer from the backside while etching occurs in the fronside of the wafer.

References:

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Growth and Characterization of a Nonlinear Optical Organic Crystal: 2,4,5-Trichloroacetanilide

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Abstract:

A nonlinear optical organic material, 2,4,5-trichlorocetanilide (245TCAA), also known as N-[2,4,5-trichlorophenyl]acetamide, has been synthesized and grown as a single crystal (Figure 1) by the slow evaporation technique by organic solvents. The grown crystals have been characterized by morphology study (Figure 2). The crystals have needle shape. Surface examination shows granular dendritic pattern in optical micrograph (Figure 3). The Differential Scanning Calorimeter plot shows no phase change until melting point (189°C). The density of the crystals is 1.69 g/cc and the crystals are soft. The crystals are transparent in the visible region and in the ultra-violet region till 310 nm. 245TCAA crystallizes with 2 molecules in a monoclinic unit cell in the non-centrosymmetric point group m, space group Pn [1]. Refractive indices of this optically biaxial crystal along the three crystallophysical axes have been measured at 633 nm. The optical second harmonic generation efficiency of the crystal at 1064 nm is about half that of the urea crystal, measured by powder method [2] using Nd:YAG laser. The results show that the 245TCAA crystal can efficiently be used for up-conversion of infrared radiation into visible green light. The powder X-ray diffraction spectrum of the crystal has been obtained.

Keywords:Organic single crystal, Growth from solution, Characterization, Second harmonic generation, Nonlinear optical material, optical micrograph.

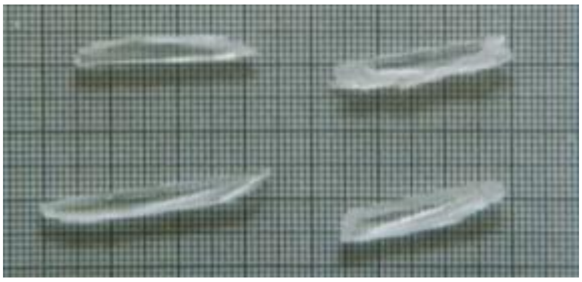

Figure 1: 246TMAA single crystals

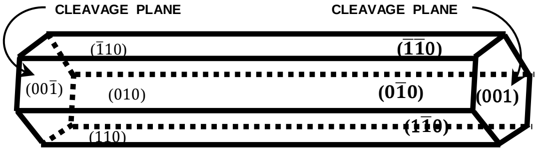

Figure 2: Morphology of 245TCAA crystal

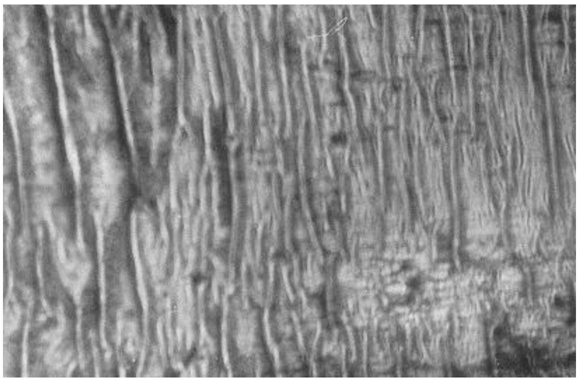

Figure 3: Optical Micrograph of (0 1 0) habit face of 245TCAA crystal

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A hidden correlation between absorption spectra of graphene nanoribbons and carbon nanotubes

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Abstract:

Methods of graphene nanoribbons synthesis are developing fast making high quality samples of ribbons more available for experimental studies. Recently, graphene ribbons with zigzag edge topology have been produced by self-assembling technique with an ultimate edge quality [1]. These structures are expected to exhibit an number of interesting properties. We present an analytical tight-binding theory of the optical properties of graphene nanoribbons with zigzag edges. Applying the transfer matrix technique to the nearest-neighbor tight-binding Hamiltonian, we derive analytical expressions for electron wave functions and optical transition matrix elements for incident light polarized along the structure axis. It follows from the obtained results that optical selection rules result from the wave function parity factor $(-1)^J$,where J is the band number (see Figure 1). These selection rules are that dJ is odd for transitions between valence and conduction subbands and that dJ is even for transitions between only valence (conduction) subbands [2,3,4]. Although these selection rules are different from those in armchair carbon nanotubes, there is a hidden correlation between absorption spectra of the two structures when their band structures are matched at the center of the Brillouin zone as shown in Figure 1. This suggests both nanostructures can be used interchangeably in optoelectronic applications. The correlation originates from the fact that van Hove singularities in a tube are centered between those in a ribbon if the ribbon width is about a half of the tube circumference. The analysis of the matrix elements dependence on the electron wave vector for narrow ribbons also shows a smooth nonsingular behavior at the Dirac points (**K** and **K'**) and the points $\mathbf{k_t}$ and $\mathbf{k'_t}$ where the bulk states meet the edge states.

Keywords: graphene nanoribbons, carbon nanotubes, optical matrix elements, optical absorption, selection rules.

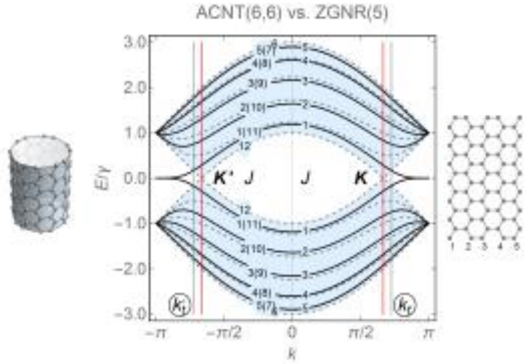

Figure 1: Matching band structures of (6,6) armchair carbon nanotube (ACNT) (dashed) and zigzag graphene nanoribbon (ZGNR) (solid) containg 5 zigzag chains.

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Photo-electrochemical study of Antimony doped SnO_2 film/ Chromate solution

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Abstract

In preceding works [1, 2, 3], we showed that the structural properties like as the growth, the shape and the size of pure and antimony doped tin oxide crystallites, the roughness as well as the transmittance and the reflectance of the deposited layers are influenced by the nature of the substrate. To compare and to better understand the effect introduced by the interfaces and the processes involved, the present study investigate the results obtained from Electrochemical Impedance Spectroscopy (EIS) and Capacitance measurements C(V) on Sb-SnO_2 thin films deposited by atmospheric pressure chemical vapor deposition process on monocrystalline and polycrystalline silicon substrates. The main objective of this work is first to show the effects of the nature and the surface of the substrate on the electrochemical properties of electrodes based thin layers of pure and doped tin oxide grown on silicon substrates then, in the second part to analyze the absorbance of antimony-doped tin oxide layer in a chromate solution under sun light. The electrochemical properties and the absorbance were examined in relationship with the variation in antimony doping level.

In this study, we found that antimony-doped tin dioxide / chromate solution structures provide variable electrochemical properties, as well as an appreciable difference in light absorbance confirming chromate degradation. The Nyquist plots on these structures show that the variation of the impedance according to the frequency confirm the influence of the substrate on the properties of transport and suggest that only the grain boundaries are responsible in the conduction mechanism of the material. In addition these properties are strongly influenced by the microstructures of the layers such as texture and crystallography measured by XRD.

Our results show also that when tin oxide is doped with antimony atoms, its photoactivity become greater compared to pure films. The antimony atoms are responsible in the degradation of the chromate solution and the increase in the doping level is responsible in the reduction of the chromate solution. In fact the Sb doping generates free electrons, responsible for the improvement of the transport properties. The capacitance measurements confirmed the n-type characteristic induced by the load compensation mechanism.

Keywords: Tin oxide, EIS, Degradation, Chrome

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PVB encapsulant polymer functionalized with luminescent down-shifting technique as emerging material

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Abstract: One way to reduce photovoltaic (PV) module losses by thermalization is the carrier multiplication, i.e. the generation of multiple electron-hole pairs from selective incident photon in the polymer encapsulant. Above 1150 nm, photons are not absorbed but can be converted by up-conversion mechanism (UC). Beneath 550 nm, the photons frequency can be shifted by down-conversion process. Actually, some of the losses can be circumvented by including a luminescent down-shifting (LDS) layer. The LDS layer absorbs UV photons before they are absorbed by the encapsulant, and emits longer wavelength photons that transmit through the encapsulant to the cell. The influence of an LDS layer on a PV module is best assessed by the measurement of the module's external quantum efficiency (EQE).The goal of frequency converters is to modify the solar spectrum and adapt it to the semiconductor spectral response **[1,2]**.

However, there have been several studies showing improvements of solar cells using various LDS materials such as organic dyes, quantum dots (QDs), and rare earth coordination complexes—mainly Eu(III) complexes. For this purpose, the most promising candidate materials as luminescence converter are those whose luminescence quantum yield has already been shown such as organic dyes pigments. Actually, organic dyes exhibit very high photo-luminescence quantum yield (PLQY) in solution, which is a fundamental property for successful LDS. They exhibit good solubility in a wide range of organic solvents and polymeric host material.

In this paper, we propose to study the feasibility to implement the downshifting functionality for PVB material and to identify suitability of available luminescent and host polymer encapsulant material. The experimental conditions such as polymer thickness, complex concentration will need to be optimized. The polymer encapsulant and organic dyes will be characterized using optical techniques (UV-visible transmission, photoluminescence…) and thermal analysis techniques (DSC, TSC and DMTA).

Keywords: Encapsulant material; Photovoltaic module; Optical properties; Thermal Analysis; Quantum efficiency; Down shifting technique

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Session III. A:

Joint Nanotech ME 2017, Biotech ME 2017

Passion fruit-like nano-architectures: generalized production and bio-applications

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Abstract:

Noble metal nanostructures have demonstrated a number of appealing features for applications to various diseases, in particular to neoplasms.[1] However, accumulation issues have prevented their clinical translation. Thus, metal nanomaterials with the most intriguing behaviors for the composition of effective therapeutics and efficient diagnostics are still on the laboratory benches.[2]

Noble metals nanostructures are not biodegradable and, despite their little size, this is not small enough to results in their excretion after the designed action. On the other hand, when the size of metal nanoparticles is decreased down to few nanometers, their functionality might be lost and their clearance from the bloodstream may become too fast, jeopardizing possible cancer applications.[3] The dilemma of making a choice between optimum particle size for clinical applications and efficient body clearance has created a serious conflict in nanotechnology**.**[4]

To bypass this issue and increase the possibility of translation of metal nanomaterials to clinics, we have introduced an innovative design to jointly combine the best properties of metal nanoparticles with their potential excretion.[3,5] Because of their resemblance with an exotic fruit, these nano-platforms have been named Passion fruit-like Nano-Architectures.

The last achievements from this novel approach will be discussed together with the next exciting perspectives.

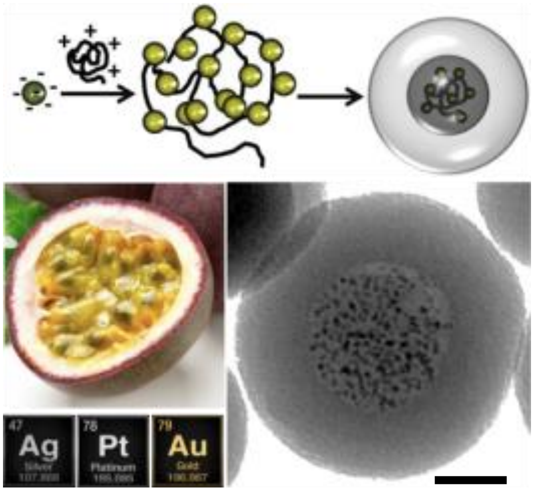

Figure 1: scheme of the process for the composition of biodegradable passion fruit-like Nano-Architectures (NAs) and a typical TEM image. Scalebar: 20 nm.

Keywords: metal nanoparticles, theranostics, cancer, photoacoustic, drug delivery, chemo(radio)therapy.

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Optical biosensors detection of mycotoxins using aptamer-based gold nanostructures

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Abstract:

The aim of this work is to develop an optical bio-sensor based on the LSPR phenomenon in nano-structured gold films suitable for detection of mycotoxins (AFTb1, AFTM, OTA) in aptamer assay based on spectroscopic ellipsometry.The method of total internal reflection ellipsometry (TIRE) was developed in the last decade as a combination of spectroscopic ellisometry and SPR and was established as a highly sensitive analytical tool in bio-sensing particularly attractive for detection of low molecular weight analytes such as mycotoxins [1]. The use of aptamers as highly specific artificial molecular receptors to mycotoxins in conjunction with the method of TIRE is reported here for the first time. DNA-based aptamers specific to mycotoxins provided by Perpignan University were immobilized on the surface of gold via thiol groups similar to that described in [2]. Gold coated glass slides with immobilized aptamers were kept in PBS or HEPES/$MgCl_2$ buffer to prevent aptamers from coiling; such preservation was sufficient for keeping aptamers active for a couple of months. Series of TIRE spectroscopic measurements showed progressive "blue" spectral shift of plasmon resonance upon binding of AFTb1 molecules in increasing concentrations from 0.01ng/ml up to 100ng/ml.Fig.1. The minimal detected concentration of AFTb1 was down to 0.01ng-ml which is ten part per trillion which is a remarkable result for direct aptamer assay format. Aptamer work in a similar way to split antibody and provide similar sensitivity , LOD was 0.01ng/ml [3]. Further work towards development of highly sensitive design of aptamer-antibody sandwich based optical biosensors for mycotoxins is currently underway.

Keywords: Optical biosensor, mycotoxins, aptamer, gold nanostructures, total internal reflaction ellipsometery.

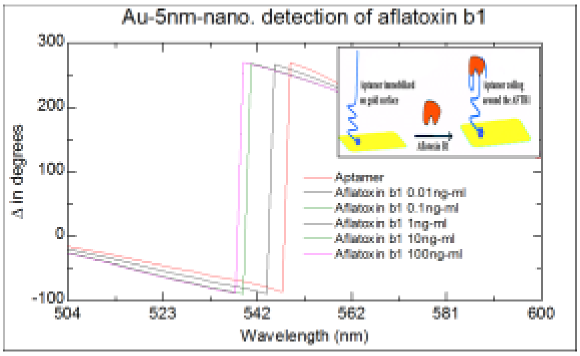

Figure 1: Figure shows the minimal detected concentration of AFTb1 was 0.01ng/ml.Inset illstruated aptamer coiling around AFTb1.

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Mycotoxin biosensor based on optical planar waveguide

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Abstract:

This work focuses on development of optical biosensor for detection of mycotoxins which are products of metabolism of numerous fungi species known by their adverse effects on human health. The safety level for mycotoxins in food and feed legislated by WHO is in ppb range which makes the detection of small mycotoxin molecules a formidable task. The traditional method, such as HPLC or mass-spectroscopy, can provide the required sensitivity but these methods are laboratory-based, expensive, and time consuming. Therefore the development of bio-sensors for mycotoxins detection is of great demand nowadays; highly sensitive optical sensors are leading in this development [1].

The planar waveguide (PW) optical bio-sensing platform has been chosen with a view of development of portable, inexpensive, though highly sensitive detectors for mycotoxins. The use of a planar waveguide operating as polarization interferometer is a logical continuation of our previous research based on SPR and spectroscopic ellipsometry [1, 2]. The PW experimental set-up was build, tested, and the preliminary results on detection of aflatoxin B1 were ecouraging [3]. In this work we report the results of further development of the PW sensor which is now capable of detection of several mycotoxins (aflatoxin B1, ochartoxin A, and zearalenone) in concentrations down to single ppt (parts per trillion), a remarkable achivement for optical sensors operating in direct immuno-assay format.

Keywords: optical biosensor, planar waveguide, polarization interferometer, refractive index sensitivity, mycotoxins.

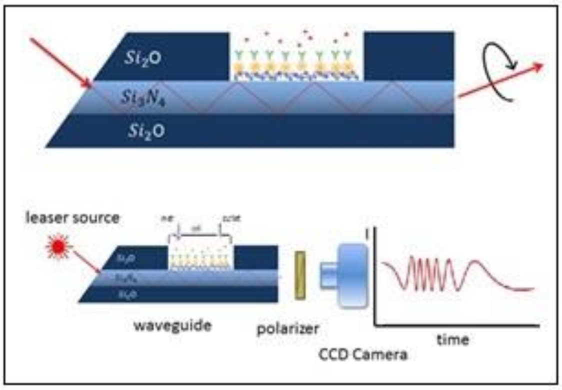

Figure 1: (a) Coupling light into planar waveguide; (b) polarization interferometer experimental set-up; output signal waveform (c).

Acknowledgement:

This work was supported by NATO SPS project NUKR.SFPP 984637.

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Nature Inspired Optical Biosensors

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Abstract

Morpho butterflies and *Tmesisternus isabellae* beetles are well known for their attractive colors originating from 3D Bragg mirror like nanostructures. Our research focuses on producing similar 3D hierarchal nanostructures through the economical process of holographic laser ablation.[1, 2] The 3D Bragg mirror like structures produced display colour selective optical properties and can be used as optical biosensors for point of care settings. We have recently developed a clinically relevant optical glucose nanosensor that can be reused at least 400 times without a compromise in accuracy.[3] The nanosensor consisted of a phenylboronic acid-functionalized hydrogel, which responded to various glucose concentrations by expanding and contracting volumetrically. The hydrogel was transparent hence to link the volumetric changes to an optical effect a multi-layered Bragg grating of silver nanoparticles was embedded within the hydrogel. Do achieve this, a 6 ns pulsed laser (λ = 532 nm, 200 mJ) was used. A single laser pulse rapidly produced off-axis Bragg diffraction grating consisting of ordered silver nanoparticles embedded within a phenylboronic acid-functionalized hydrogel. The sensor exhibited reversible large wavelength shifts and diffracted the spectrum of narrow-band light over the wavelength range λpeak ≈ 510–1100 nm. The experimental sensitivity of the sensor permits diagnosis of glucosuria in the urine samples of diabetic patients with an improved performance compared to commercial high-throughput urinalysis devices. The sensor response was achieved within 5 min, reset to baseline in ~10 s. It is anticipated that this sensing platform will have implications for the development of reusable, equipment-free colorimetric point-of-care diagnostic devices for diabetes screening.

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Improved Anticancer Activity of siRNA/Calcium Phosphate Nanoparticle Systems in Lung Cancer Cells

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Abstract:
siRNA (small interfering RNA) based approaches have therapeutic potency by inhibiting the expression of disease causing gene [1]. Since cancer is a genetic disease, it is required to investigate the highly expressed oncogenes and develop a new generation treatment strategies [2]. The over-expression of survivin and cyclin B1 genes in non-small cell lung cancer, which are responsible for hinderance of apoptosis and induction of cell proliferation, respectively, makes them a potential molecular target for siRNA-mediated gene silencing therapy [3,4]. However, for a safe siRNA administration into target cells, a proper carrier system is needed. Calcium phosphate (CaP) nanoparticles have been emerged as a transfection reagent since 1970s due to their non-toxicity, biocompatibility and high gene loading capacity [5].

The aim of this study is to evaluate the anticancer efficacy of siRNA (survivin and cyclin B1) attached CaP nanoparticles in non-small cell lung cancer cells, A549. By sol-gel method, we generated spherical-like hydroxyapatite (HA-s), needle-like hydroxyapatite (HA-n) and calcium deficient hydroxyapatite (CDHA) nanoparticles to use as siRNA carrier. To increase siRNA attachment, the nanoparticles were decorated with arginine (Arg) to gain positive moieties. The physicochemical and morphological characteristics of the nanoparticles were investigated systematically by means of XRD, FTIR, SEM, TEM and DLS analysis. The cells were treated with HA-Arg-siRNA formulations and siRNAs alone. The knockdown of the genes was confirmed by RT-PCR analysis. MTT test was used to indicate the cytotoxic effect of the systems on cells. Cell cycle and apoptosis analysis were conducted by using Flow Cytometry. The results revealed that inhibition of survivin and cyclin B1 genes in A549 cells via different HA-Arg nanoparticle delivery vehicles exhibited enhanced therapeutic activity when compared to the ones, without nanoparticle. With advanced siRNA binding ability, non-toxic and ease of synthesis properties three modified CaP nanoparticles were found to be favorable materials as transfection agents for the treatment of non-small cell lung cancer.

Keywords: calcium phosphate nanoparticles, siRNA, survivin, cyclin B1, non-small cell lung cancer

Acknowlegment: The authors would like to thank TUBITAK 214S036 project for financial support.

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Core fucosylation of Asn297 glycosylation site effects on IgG2-based therapeutic monoclonal antibodies biological and biophysical properties and fucosylation kinetics

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Abstract:

A combination of protein expression in glycosylation-deficient yeast and in vitro enzymatic synthesis was utilized to produce homogeneous high mannose, hybrid and Fuc(+) hybrid IgG2 Fc glycoforms for IgG2-based monoclonal antibodies optimization studies. During these studies, novel methods were developed to recombinantly express mouse α1,6-fucosyltransferase (FUT8) in E. coli for rapid production of the enzyme for synthesis and kinetic studies. Biophysical studies were conducted to compare the hybrid and Fuc(+) hybrid glycoforms of IgG2 Fc. The addition of core-linked fucose to IgG2 Fc did not appear to perturb the conformational stability of the Fc as measured using a variety of biophysical techniques. Kinetic binding studies of the interactions of Fcγ receptors with hybrid and Fuc(+) hybrid IgG2 Fc glycoforms were also carried out. Addition of core-linked fucose had no effect on the affinity of IgG2 Fc for FcγRIIa-H131; however, it eliminated hybrid IgG2 Fc's already weak affinity for FcγRIIIa-V158. FUT8 kinetics studies of transfer of core fucose to free glycan compared to IgG2 Fc N297 bound glycan showed about 10 fold differences in K_M but interestingly same V_{max} indicating lower affinity of FUT8 for protein bound glycan but similar transition states for both glycans. Enzyme kinetics studies also showed faster GnT-I and FUT8 reaction kinetics on N297 than N392 glycosylation sites. These differences in glycosyltransferase glycosylation site substrate specificities could indicate differences in site accessibility and/or dynamic protein structures around the different glycosylation sites, and can explain cases where dissimilar types of glycosylation are observed among different glycosylation sites on the same protein.

Keywords: monoclonal antibodies, N-glycosylation, core fucose, stability, enzymatic synthesis, IgG2, α1,6-fucosyltransferase (FUT8)

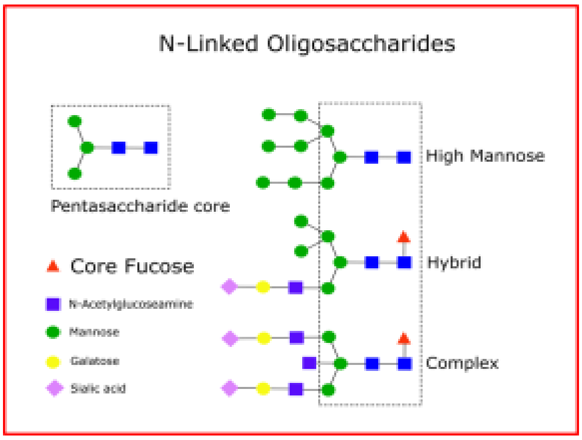

Figure 1: Figure illustrating the structure of different types of IgG N-glycosylation and the position of core fucose within the Asn297 glycan

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Aflatoxin M_1 Decontamination Potential of Free and Immobilized *Lactobacillus plantarum* and *Lactobacillus fermentum*

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Abstract:

Aflatoxins are secondary metabolites produced by the mycelia or spores of toxigenic filamentous fungi e.g. *Aspergillus flavus*, *A. parasiticus*. Among them, Aflatoxin M_1 (AFM_1) is the metabolite of aflatoxin B_1 (AFB_1), produced as a result of AFB_1 hydrolysis. These toxins are produced when the animals consume feedstuff polluted with toxigenic fungi and are associated with health hazards e.g. carcinogenesis, reduced protein synthesis, immunosuppression. Decontamination of these toxins can be done through physical, chemical or biological methods. Among them biological decontamination approach using microorganisms is the most recurrently applied one and is very promising choice due to its efficiency, specificity, cost-effectiveness and environmentally friendly nature. Lactic acid bacteria (LAB) are frequently employed as AFM_1 binding agents in milk because of their GRAS nature, rapid and high binding abilities along with wide distribution in nature. In the current study we were able to isolate promising lactic acid producing *Lactobacillus plantarum* (KX388384) and *Lactobacillus fermentum* (KX388385) for the decontamination of AFM_1 from milk samples. The cultures were initially used in viable and non-viable forms (acid or heat killed) and their AFM_1 decontamination potential was determined using competitive ELISA. Both the strains showed significant AFM_1 adsorbing abilities, while the heat killed cells showed the highest potential. In order to determine the effect of immobilization on adsorbing abilities and to determine their functional stability, both strains in viable and non-viable forms were also encapsulated within sodium alginate beads (Figure 1). Heat treatment of cells greatly increased the toxin binding ability. While in case of acid killed cells, higher aflatoxin M_1 binding ability as compared to their viable cells but significantly lower than their heat killed counterparts, was observed. As a result of immobilization, binding abilities was reduced while functional stability was improved. The functional stability and reusability analysis revealed that LAB cells can be utilized for more than one cycle. However, a decline in their aflatoxin binding ability after each cycle was observed. The encapsulation helped out in the easy recovery and multiple reuses of LAB cells. The findings of the current study will be helpful in aflatoxin decontamination, without destroying the nutritional value of milk and milk products, thus in the remediation of aflatoxin associated health hazards.

Keywords: Aflatoxin M_1 Decontamination, Encapsulation, Lactic acid bacteria, Sodium Alginate, ELISA.

Figure 1: Sodium alginate beads encapsulating *Lactobacillus* cells (Viable or Non-viable).

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Ultrasound Enhanced Release of Active Targeting Liposomes Used for Cancer Treatment

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Abstract:
Liposomes are popular lipid bilayer nanoparticles that are highly efficient in encapsulating both hydrophilic and hydrophobic therapeutic drugs. Liposomes promote a low risk controlled release of the drug avoiding the side effects of the conventional chemotherapy. One of the great potentials of liposomes is the ability to attach a wide range of ligands to their surface producing ligand-mediated active targeting of cancer tumour with limited adverse off-target effects. Ultrasound can also aid in the controlled and specified release of the drug from the liposomes by breaking it apart and releasing the drug in the specific location where the ultrasound is applied.

Our research focuses on the synthesis of PEGylated liposomes (contain poly-ethylene glycol) encapsulated with the model drug calcein and studying the effect of low frequency ultrasound applied at different power densities on calcein release. In addition, Moieties are attached to the surface of the liposomes for specific targeting of the cancerous cells which over-express the receptors of these moieties, ultrasound is then applied and the release results are compared with the moiety free liposomes. The results showed that attaching theses moieties to the surface of the PEGylated liposomes not only enhance their active targeting but also stimulate calcein release from these liposomes.

Keywords: Active targeting, Liposomes, Moieties, Ultrasound

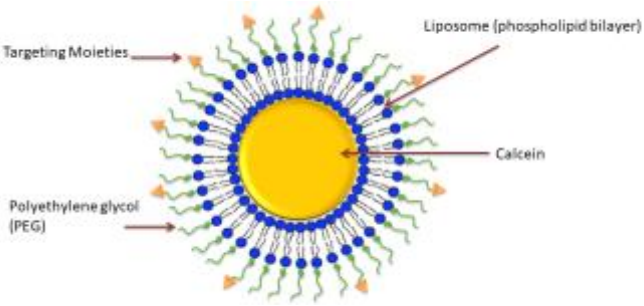

Figure 1: Figure illustrating the targeting liposomes encapsulating calcein .

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Session III. B - Joint Nanotech ME 2017, Surtech ME 2017:

Nanotechnology for environment applications

Novel Ionic Liquids based Nanocomposite Catalysts for Direct Conversion of CO_2 and Methanol into Dimethyl Carbonate

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Abstract:

The conversion of carbon dioxide (CO_2) into dimethyl carbonate (DMC) has been focused by applying various homogeneous and heterogeneous catalysts. Though some routes for CO_2 conversion into DMC are available, they may have disadvantages such as a toxic reactants, toxic by-product as well as high production cost. However, direct route of DMC synthesis using CO_2 and methanol as a reactant has a merit as environmental begin process. However, this route has some limitations such as equilibrium shift problems, low conversion of methanol, and un-recoverable catalyst. Ionic liquids (ILs) and ILs-based nanocomposite materials can be used as a remarkable catalyst system for this route, because they can be easily tuned to adjust the properties by incorporating cationic and anionic ions, metal oxide, making bi-functional, adding acidic and basic functionalities, etc. In the present work, a variety of new ILs and ILs-based polymer/metal oxide catalyst systems for a direct conversion of CO_2 and methanol into DMC will be introduced: e.g., around 13.01% methanol conversion and 99.13% DMC selectivity over [EmimOH][NTf_2] IL / SmOCl catalyst system in presence of organic super base (i.e., DBU). Here the roles of SmOCl, DBU and IL for the activation of methanol and CO_2, were examined. In another example, the tricationic IL as a catalyst along with DBU was also investigated to enhance the methanol conversion up to 37% with 93% DMC selectivity. The additional catalyst systems such as polyhydroxyl/amino functionalized biopolymer (chitosan), $CuCl_2$@Poly-GLY(1-vim)$_3$(OMs)$_3$ were tested.

Keywords: Ionic liquid, Carbon dioxide, Dimethyl carbonate, Propylene carbonate, Cyclic carbonate, Catalytic system, Dehydrating agents.

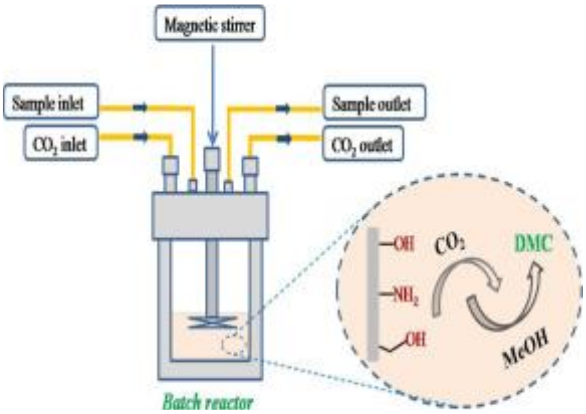

Figure 1: Synthesis of DMC from CO_2

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Nanopyroxene Grafted with β-CD Polymer for Produced Water Treatment

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Abstract:

The oil and gas industry produces a large amount of water as a result of the extraction process. This produced water typically contains appreciable amounts of dissolved organics compounds and heavy metals. Despite the fact that the adsorption process has shown promising results for the removal of these contaminants, they still lack several properties that can be best estabilished using nanoparticles according to their many proven advantages.

Nanoparticle surface can be modified to ensure its affinity and selectivity towards the targeted contaminants. This is achieved via the grafting technique using an environmentally friendly polymer targeted towards the removal of dissolved organic compounds and heavy metals in produced water.

In this study, nanoparticles have been grafted with β-Cyclodextrin polymer; an environmentally friendly polymer with high affinity for the removal of organic compounds. This was acoomplished using a hybrid organic-inorganic material. Illustrations of the modified nanoparticles are shown in Figure 1.

The yielded nanoparticles were fully characterized to confirm their textual surface properties and the morphology using FTIR, TGA, BET, XRD, HRTEM and AFM. Computational modeling was also conducted to provid a deep insight on the grafting two-step reactions as well as for the adsorption mechanism for the contaminant removal. We are presenting the preparation and characterizations of the tailor made grafted pyroxene nanoparticles that shows promising potential for future applications in produced water treatment.

Keywords: Produced water, nanoparticles, β-CD, polymer grafting, adsorption.

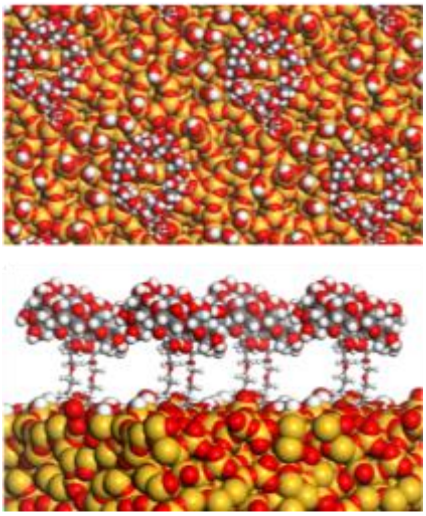

Figure **1:** Figure illustrating Top and side views of the optimized composite material formed by the β-CD molecule (CPK representation) bonded to two hydrolyzed 3GT molecules (ball and stick representation) which are anchored to two hydroxyls groups onto the silica surface (CPK representation). Red atoms represent oxygen, grey atoms represent carbon, white atoms represent hydrogen and yellow atoms represent silicon.

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Modeling and Experimental Study of Carbon dioxide capture in an Absorption column using Nanofluid

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Abstract:

The increasing concentration of CO_2 in the atmosphere, contributing potential negative impact to the environment has been the subject of worldwide attention over the past few decades. CO_2, one of the main greenhouse gases is getting emitted to the environment from different industries. Gas scrubbing, using aqueous alkanolamine solutions, has been the best option for post combustion carbon dioxide capture in recent days. In this study, the suspensions of alumina nanoparticles in MEA (monoethanol amine) are developed and estimated to apply it to absorb CO_2 gas. The nanofluids are prepared by the ultrasonic treatment and show good stability. It is found that the CO_2 absorption rate by the nanofluid is enhanced up to 31% & 8.2% compared to the pure water and MEA solutions, respectively. The CO_2 absorption characteristics were experimentally examined in a packed bed of raschig rings, under various process conditions like gas flow rates and liquid flow rates and solvent and nanoparticle concentrations. The present investigation dealt with a comparative study of absorption behavior of pure MEA and MEA along with alumina nanoparticles. The effect of pH on the absorption of CO_2 was also studied. It was compared on the basis of percentage CO_2 removal, effective mass transfer rate and overall mass transfer coefficient. The maximum percentage of CO_2 removed using 1% (wt/wt) MEA and 0.03% alumina nanoparticle is 97.8%.

Keywords: carbon dioxide capture, monoethanol amine, alumina nanoparticles, absorption, packed bed column, nanofluid.

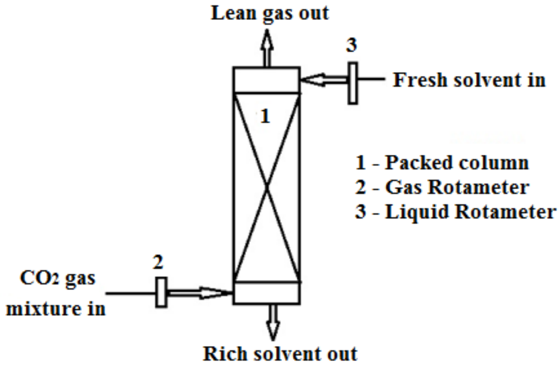

Figure 1: Experimental setup for Carbon dioxide capture by absorption: Nanofluid consisting of MEA and alumina nanoparticles was used as solvent.

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Ultrasound Assisted Oxidation of *p*-nitroaniline by Synthesized Ferroferric Oxide Encapulated Guaran Nanocomposite

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Abstract:

Ferroferric oxide encapsulated guaran nanocomposites can be effectively used as a catalyst for the degradation of recalcitrant organic contaminants in wastewater. This catalyst was prepared through a simple ultrasound assisted liquid-phase co-precipitation method and were characterized using X-ray diffractometry, field emission scanning electron microscopy and high resolution transmission electron microscope for their crystal structure, size and morphology of the core/shell catalyst. The sonochemical process or ultrasound treatment process has been an attractive and effective one due to its several beneficial factors when compared to other advanced oxidation processes. This ultrasound process when applied involves the formation, growth and collapse of transient cavitation bubbles. During this process temperature and pressure of higher degrees would be generated as per Hot Spot Theory leading to production of highly reactive hydroxyl and hydrogen radicals. The radicals were utilized for the oxidation of the treatment of pollutants. In this study highly toxic *p*-nitroaniline was treated by sonochemical oxidation process and further exceptional improvement was achieved by the addition of sodium periodate. The *p*-nitroaniline is an organic non-biodegradable compound used as an intermediate or precursor in the manufacture of organic synthesis such as azo dyes, antioxidants, fuel additives, corrosion inhibitors, pesticides, antiseptic agents and the synthesis of pharmaceuticals. The effect of experimental parameters such as initial solution pH, catalyst dose, *p*-nitroaniline concentration and sodium periodate concentration were varied and their effect of the degree of treatment were studied and reported. The treatment efficiency of 94% in 120min. of reaction time was achieved at optimized condition. A feasible reaction mechanism for the degradation of *p*-nitroaniline was presented.

Keywords: Ferroferric oxide, Guaran, Ultrasound, *p*-nitroaniline, catalytic oxidation.

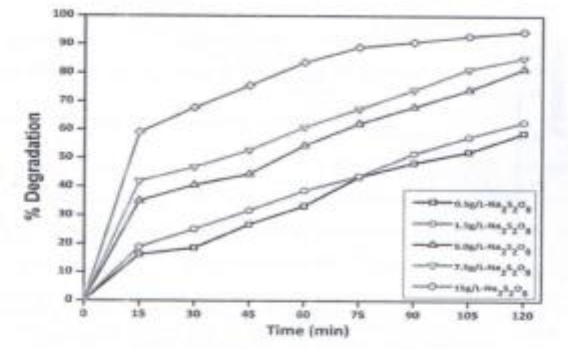

Figure 1: Figure illustrating the fundamental question that we are tempting to solve experimentally: what is the importance of silica surface modification nanoporous silica-based sol-gel glasses prepared from functionalized organosilane precursors on the parameters affecting the conformation, biological activity and functionality of encapsulated biomolecules.

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Polyelectrolyte coated electrospun Polyacrylonitrile (PAN) Nanofiber membrane to remove Cu^{2+} metal ions

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Abstract:

Heavy metal ion pollution from wastewater has become one of the most serious environmental problems. Unlike organic contaminants, metal ions are extremely carcinogenic and non-biodegradable which intend to accumulate in living organisms. Electrospun polyacrylonitrile (PAN) nanofiber membranes were prepared through conventional electrospinning process and followed by surface coating with polyelectrolyte (polyanions and polycations) polymer through layer by layer coating technique. The prepared PAN nanofiber membranes were hydrolyzed to enhance the surface hydrophilicity (wettability ~ 24°) when compared to controlled PAN membrane (Wettability ~40°). PAN membrane was coated with selective polyelectrolytes polymer for enhanced adsorption/rejection of metal ions. Surface, compositional, thermal and wettability analysis of the control PAN and polyelectrolytes coated PAN membranes were confirmed by using scanning electron microscope (SEM), Thermal gravimetric analysis (TGA) and water contact angle measurement. SEM images confirm the uniform distribution of nanofiber morphology with average fiber diameter around 200nm. FTIR spectra of surface coated polyelectrolyte/PAN membrane exhibits characteristic peaks at 1110 cm-1 and 1040 cm-1 originating from symmetric and asymmetric stretching of O=S=O from sulfonate groups of polyelectrolytes polymer was observed. XPS analysis also confirms a predominate S2p (167eV) and N1S (402eV) peaks of the polyelectrolytes polymer. The static adsorption capacity of surface coated polyelectrolytes /PAN membranes was around 150 mg/g for Cu^{2+} metal ion at pH 6 and Concentration (150ppm). This study demonstrates the potential of polyelectrolytes/PAN composite membrane as filters to remove the Cu^{2+} metal ion at optimum polyelectrolyte coating. Developed surface coated polyelectrolyte/PAN nanofiber membrane will provide clean, fresh and safe drinking water, thereby significantly improve the health of the population at risk due to poverty and low hygiene.

Keywords: PAN Nanofiber; Polyelectrolytes, Nanoporous; Coatings; Metal ion removal

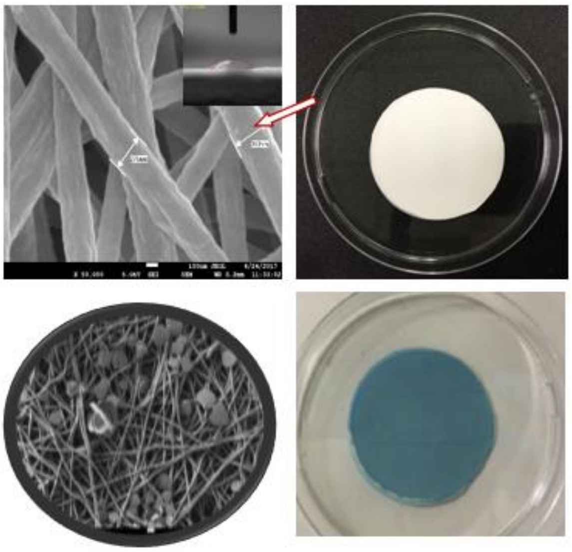

Figure 1: SEM image of Polyelectrolyte coated electrospun PAN nanofiber membrane before and after Cu^{2+} metal ion filtration.

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Effect of different parameters on the properties of prepared cellulose acetate membranes

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Abstract:

Membrane technology, as an advanced separation technology, have been demonstrated to be a practical and competitive alternative [1], in comparison to methods such as adsorption, coagulation, biodegradation, chemical degradation and photodegradation, for the removal of pesticides, dyes, pharmaceuticals, drugs, antibiotiotics, personal care products, surfactants, etc. from domestic and industrial wastewater.

The most common membranes are polymeric and are made of several polymers ranging from hydrophilic cellulose acetate (CA) to highly hydrophobic polymers, such as polyethylene (PE) and polypropylene (PP) [2]. Since CA membranes are hydrophilic and have an isoelectric point of 3.5, they foul less than their hydrophobic counterparts [3].

Recent advances in nanotechnology combined with membrane separation have been recognized some viable and effective approaches to enhance membrane performance with their synergistic effects for water and wastewater treatment. Among the numerous concepts proposed, the most promising to date include zeolitic and catalytic nanoparticle coated ceramic membranes, hybrid inorganic–organic nanocomposite membranes, and bio-inspired membranes such as hybrid protein–polymer biomimetic membranes, aligned nanotube membranes, and isoporous block copolymer membranes [4]. Overall, bio-inspired membranes are farthest from commercial reality, but offer the most promise for performance enhancements; however, nanocomposite membranes offering significant performance enhancements are already commercially available.

Herein, we present the preparation of flat sheet CA membranes through the phase inversion method, which served for long as a model for the study of the mechanism of formation of several membranes from the day it was invented [5]. Hence, it is worthwhile to investigate further into the phase inversion of CA membranes to explore new progress that might have been overlooked in the past and yet can be good supplement to the traditional theories.

We report the effect of different parameters (cellulose acetate content, solvents at the coagulant baths, and casting substrate) on the porosity, pore sise distribution, hydrophilicity, water permeability and flux. The enhancement of the properties will be dependent on the microstructure of the CA induced by the nature of the functional groups (acetyl and hydroxyl) and the interactions with solvents and casting substrates. The characterization by SEM and DSC will give additional information.

In the near future, we will introduce new challenges of using this type of CA membranes combined with modified multiwalled carbon nanotubes in water treatment.

Keywords: cellulose acetate membranes, phase inversion method, porosity, hydrophilicity, water permeability, flux.

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AlOOH-TiO_2 dual nanostructures with anti-oil fouling nature for oil-water separation

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Abstract:
We presented a nanostructured functional mesh filter with dual nanostructures of nanoflake and nanoparticle clusters. The aluminum (Al) mesh surfaces show the long-term superhydrophilicity/underwater superoleophobicity formed by boiling containers having an Al mesh and TiO_2 nanoparticles. As Al and TiO_2 nanoparticle immerse in boiling water, the Al surface reacts hydroxyl ion decomposed water to form flake-like structure confining TiO_2 nanoparticles inside, to form dual nanostructures. Pristine Al mesh filter shows superhydrophilic but not lasted for longer duration, while the mesh filter with dual nanostructures of TiO_2 and Al nanoflake has long-term stability in hydrophilicity due to structure and TiO_2 effect. The hybrid nanoclusters have very low wetting angle of near 0 degree in air and superoleophobic underwater for more than 10 weeks, showing long-lasting anti-oil nature. We applied this surface to separate oil/water for a mesh filter as well as an oil collecting device, which are required for continuous oil-water collection-separation-release process.

Keywords: Dual nanostructure, TiO2 nanoparticles, superhydrophilicity, anti-oil fouling

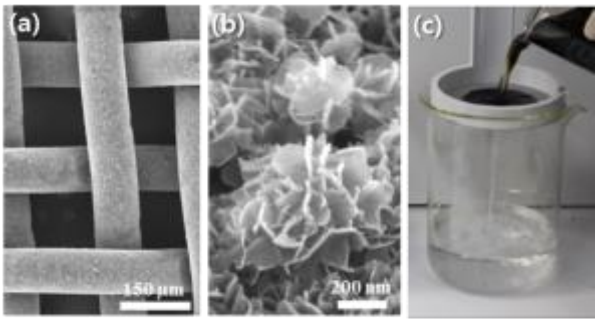

Figure 1: SEM images of (a) AlOOH-TiO_2 mesh, (b) AlOOH-TiO_2 dual nanostructures and (c) images of AlOOH-TiO_2 mesh filter for crude oil/water separation.

Corrosion monitoring of gold and silver nanoobjects in drinking water vs. simulated body fluid

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Abstract:

Gold and silver nanoparticles have a wide range of application in industry and research focused on their redox, thermodynamic properties is of high interest due to the possibility to come into touch with drinking water and human body. Size effect, concentration, surface treatment after interaction with complex agents, organic molecules or biomolecules can lead to changes in their corrosion properties. Mobility and bioaccess of Ag NPs depend on these factors, which affect their chemical reactivity during transit inside body. And this phenomena could dramatically change life-time of any nanoobject [1].

Especially Ag NPs found increasingly in everyday products to combat harmuf bacteria and viruses and exposed to normal water based environment frequently react with sulfides which limiting their toxicity [2]. It was proofed that dierent sizof NPs could differ in mechanism of oxidation compared to bulk silver [3].

This study compares results obtained by corrosion technique based on electrochemical experiments vs. quantum chemical calculations. By hyphenation of these techniques it is possible to assess redox, thermodynamic properties of metallic nanoobjects which finally lead for prediction of their service-life.

From quantum chemical calculation using conventional LDA and semiempirical method PM6 on Fig. 1 it seems that HOMO-LUMO orbitals totally moved to the position on Ag nanocluster and energy gap decrease rapidly. We have observed that addition of vitamin C served as corrosion inhibitor and minimize run-off effect of silver inons into simulated body fluid for at least 5 hours. Explanation came from the fact that vitamin C is donor of electrons for limited time during exposition of Ag NPs to environment. The surface layer of 50 nm thick Ag_2S was detected by FIB microscopy on Ag NPs exposed for 24 hours in Hank solution. The corrosion rate of AuSi nanoarchitectures measured by semi-quantitative polarization technique was around 0.29 mpy, compared to 0.45 mpy for Ag nanoparticles after 24 hours exposition [4].

Keywords: corrosion of nanoobjects, nanosafety, sustainable nanotechnology, redox properties of nanosystems, biomedical applications.

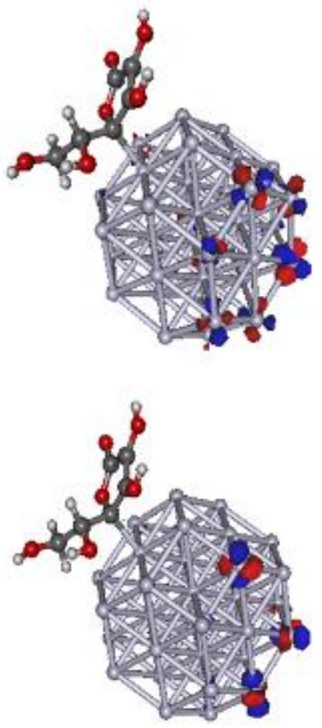

Figure 1: Figure illustrating cluster of hybrid system Ag nanoparticle with 1.6 nm in diameter and attachment of ascorbic acid molecules. Model served for assessment of changes joined with redox, thermodynamic and corrosion properties using quantum-chemical calculation by calculation of HOMO and LUMO orbital energy gaps.

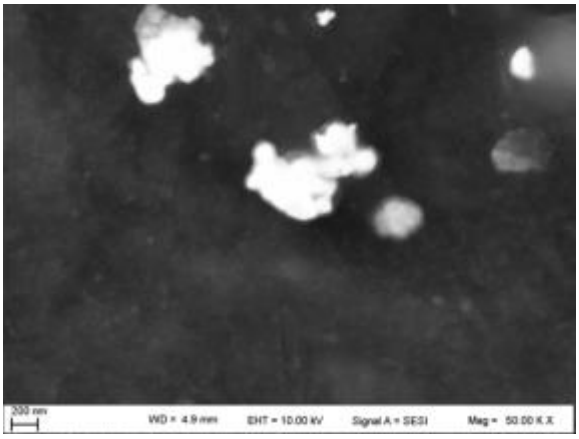

Figure 2: Small size agglomerates of Ag nanoparticles covered by thin layer of Ag_2S after 24 hours of exposition in Hank solution as product of low corrosion rate of about 0,5 mpy.

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Posters Session I:
Nanotech ME 2017 / Surtech ME 2017

Synthesis of a new artificial linker resorc[4]arene-based system for immunosensors development

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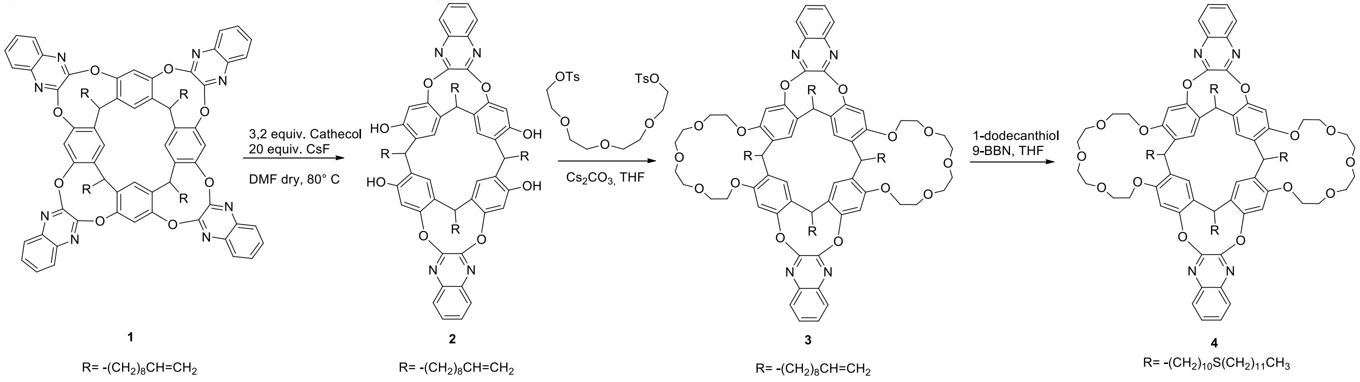
Abstract:

Immunosensors are analytical devices in which the immunochemical reaction is coupled to a transducer. The peculiarity of all immunosensors consists in the specific molecular recognition of antigens by antibodies to form a stable complex. One of the main problems in the development of immunosensors is to overcome the complexity of binding antibody to the transducer surface. In fact, antibodies need to be immobilized with a high density and a right orientation to allow the easy detection of antigens. In previous works[1,2], resorc[4]arene molecules proved to be able to immobilize enzymes and antibodies as biological component of ligand-based biosensor. Aim of this work is to develop an artificial linker resorc[4]arene-based system **4** for the site-directed antibodies immobilization, in view of the development of enhanced immunosensors. The synthesis of **4** relied on crown-ether groups attached at the upper rim[3]. In particular, the selective abstraction of two quinoxaline units from the tetraquinoxaline-spanned cavitand **1** afforded resorc[4]arene **2** in 60% yield. The crown-ether **3** was obtained in 35% yield by the reaction of **2** with tetraethylene glycole ditosylate under Williamson ether synthesis condition. Coupling of 1-dodecanethiol to the terminal carbon atoms of the fourfold vinylic resorc[4]arene **3** was achieved by anti-Markovnikov addition with 9-borabicyclo[3.3.1]nonane (9-BBN), leading to the formation of the tetrasulfide **4** (80% yield). The immobilization characteristics of the artificial linker resorc[4]arene and surface coverage of adsorbed antibody on the molecular linker system will be evaluated by means of both Electrochemical Impedance Spectroscopy (EIS) and Surface Plasmon Resonance (SPR)



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Synthesis, Growth and Characterization of Acetophenone-4-Quinoline-D Chalcone Single Crystal: A Potential Nonlinear Optical Material

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Abstract: The new potentially useful nonlinear optical (NLO) organic material Acetophenone-4-quinoline-D chalcone has been synthesized using claisen-schmidt condensation reaction method and single crystals were grown by slow evaporation solution growth technique. Powder x-ray diffraction (XRD) study was carried out to determine the structure of the compound. It was observed that the crystallite size varies from 10^{-10} to 10^{-9} with increase in angle, it may be due to compressive strain developed in the crystal. It has been observed that dislocation density, micro strain and distortion parameter changes randomly due to mismatch in the atoms or ions. The thermal stability of the compound was determined using differential scanning calorimetry (DSC) method. It was found that melting point of the crystal is found to be 150.4 °C. The UV-Visible absorption study of the crystal was carried out using UV-Visible spectrophotometer over the spectral range 300 - 1200 nm at room temperature. It was observed that the sample has good transparency window in the entire visible and near IR region. The second harmonic generation (SHG) efficiency of the crystal was recorded using powder technique using Nd:YAG laser and is found to be 1.5 times that of reference sample urea of identical particle size.

Keywords: Characterization, Growth from solution, Organic compounds, Optoelectronic material, Nano electronics

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Synthesis of $Ni(OH)_2$/ZnO Core-Shell Nanostructured Electrodes for Improving Supercapacitor Performance by a Hydrothermal Method and Atomic Lyer Deposition

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Abstract:

The rapid development of the global economy, along with excessive fossil fuel depletion and CO_2 emission, poses a serious challenge relating to the environment, human health and energy security but has also inspired a growing demand to develop new types of sustainable and renewable energy sources and storage systems, such as batteries and capacitors [1]. Electrochemical supercapacitors, as one type of novel power device, have attracted universal research interest because of their great potential to be applied in many fields. Based on the charge-storage mechanism, supercapacitors can be classified into two types: electrochemical double-layer capacitors (EDLCs) and pseudo-capacitors. And, the electrochemical energy conversion and storage performance of pseudo-capacitors depends strongly on the intrinsic properties of the active electrode materials [2]. Typical pseudo-capacitive electrode materials consist of transition metal oxides/hydroxides, such as NiO, Co_3O_4, MnO_2, $Ni(OH)_2$ and etc., and conducting redox polymers, such as polyanilines, polypyrroles, and polythiophenes. Among these various pseudo-capacitive materials, $Ni(OH)_2$ has been recognized as a promising electrode material because of its high theoretical capacitance, low cost, and good thermal and chemical stability. However, because of the high electrical resistivity, $Ni(OH)_2$ electrodes remain unable to achieve high theoretical capacitance in practical applications.

Herein, therefore, we design and fabricate a novel hybrid 3D $Ni(OH)_2$@ZnO nanostructured electrode material with a high surface area and high conductivity using a hydrothermal method and Atomic Layer Deposition (ALD). ALD-ZnO thin films were deposited on the surface of a 3D porous $Ni(OH)_2$ nanostructure with various thicknesses at low temperature to determine the optimal thickness for both high conductivity and electrochemical performance with no Ni(OH)2 phase transformation. This hybrid 3D core-shell structure, which benefits from the synergistic effects of both $Ni(OH)_2$ and ZnO, is expected to open up new pathways for developing hybrid electrode materials for high-performance supercapacitors via ALD-electroactive metal oxide coating.

Keywords: $Ni(OH)_2$@ZnO core-shell architecture; Supercapacitor; Hydrothermal method; Atomic layer deposition (ALD).

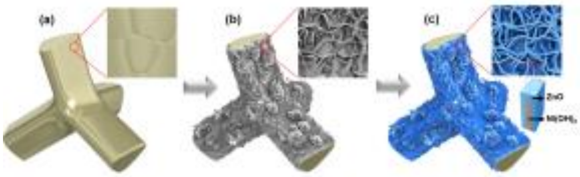

Figure 1: Schematic diagram illustrating the preparation process for $Ni(OH)_2$@ZnO core-shell nanostructures on a Ni foam substrate: (a) bare Ni foam, (b) hydrothermal Ni(OH)2 nanostructure on Ni foam and (c) $Ni(OH)_2$@ZnO nanostructure by ALD deposition.

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A Study of HMDSO plasma during nanoparticles growth using sinusoidal Pulse Low Frequency plasma polymerization

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Abstract:

Nanoparticles have been observed encapsulated in thin layers deposited from pure Hexamethyldisiloxane (HMDSO) [1]. The aim of this work is the study of the powder or the dusty plasmas formation and the growth process of these nano-particles in the both plasma discharge and films deposited.

The plasma discharge was generated from pure HMDSO precursor in low frequency reactor. Plasma discharge has been study using optical emission spectroscopy in order to reveal the mains species responsible of the powder formation. It has been observed a cloud of dusty in plasma discharge for high discharge power value. Whereas, the dusty are absent in the plasma for low discharge power. The study of optical emission spectroscopy reveal the presence of CHO bands situated at 335 and 355 nm in dusty plasmas only (for high discharge power) and the absence of these two bands for low discharge power (no dusty observed in the plasma discharge). The intensities of these bands have been investigated during discharge plasma, the variation of the intensities indicated that these species have a significant role during the process of dusty formation. The FTIR spectroscopy has been used and correlated with optical emission spectroscopy for further investigated.

Instead of controlling the width of the pulse [2] of the applied voltage, this last will be changed according to the plasma, the monitoring of resonance frequency related to plasma changing in the presence of powder always takes value between (210 – 230 Hz), this results are correlated with the results of WCA and FTIR.

Keywords: Nanopaticles, powder, HMDSO pulse low frequency plasma, dusty plasma , optical emission spectroscopy, superhydrophobic surface.

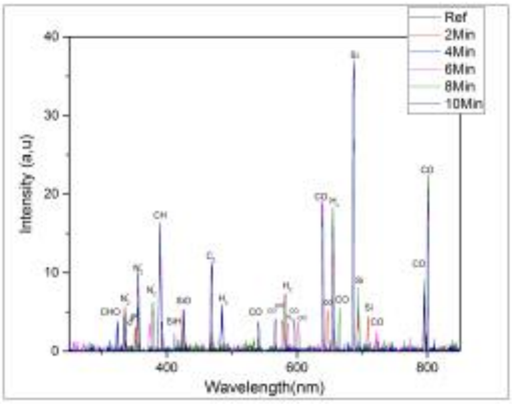

Figure 1: typical emission spectrum of HMDSO plasma under pulse wave discharge of 26 W.

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Hyper-Crosslinked Polymers and Nanocomposites realized through a versatile high yield process

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Abstract:

Hyper-crosslinked polymers (HCPs) are a class of microporous organic polymers (MOPs) particularly appealing for their high specific surface area (SSA), thermal and chemical stability. HCPs are usually prepared by extensive hyper-crosslinking of styrene-based precursor beads obtained by suspension polymerization. [1] In this work we describe a new synthetic route based on the bulk prepolymerization of a styrene-based precursor polymer, followed by hyper-crosslinking. [2] The proposed approach allows obtaining HCPs with comparable SSA to those prepared through typical suspension prepolymerization [3], furthermore letting easily disperse functional nanofillers in the HCPs, leading the way to the obtainement of Microporous Organic Polymer Nanocomposites (MOPNs). In this way, HCPs based on styrene, vinylbenzyl clhoride, and divinylbenzene and hyper-crosslinked nanocomposites containing two high surface area nanofillers, graphene nanoplatelets and surface modified graphene oxide, were prepared. Graphene oxide was priorly functionalized by grafting of poly(vinylbenzyl chloride), to improve the nanofiller dispersion in the polymer matrix and induce its participation to the hyper-crosslinking reaction through the grafted polymer layer. In particular, graphene oxide surface modification allowed creating a new class of MOPNs based on peculiar interphase microporosity. The obtained MOPs and MOPNs were fully characterized by spectroscopic, morphologic, surface area and porosity analyses. MOPs and MOPNs adsorption capacity towards gases and organic substances from water solution was investigated, elucidating the effect of the interphase microporosity on the nanocomposites adsorption properties. Finally, MOPs and MOPNs were tested as functional fillers in polymer matrixes for water remediations, inducing effective improvements in the adsortpion capacity of the composites.

Keywords: Hyper-crosslinked polymers; graphene; nanocomposites; gas adsorption; water remediation.

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One step facile synthesis of hetero structured Ag-Ni bimetallic nanoparticles by seed less approach

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Abstract

Synthesis of Ag-Ni bimetallic nanoparticles was carried out in an one step process of chemical reduction of aqueous solution to metal salts ($AgNO_3$ + $Ni(NO_3)_2$) using ascorbic acid as reducing agent in presence of two stabilizers (cationic cetyltrimethylammonium bromide, CTAB and anionic sodium dodecylbenzenesulphonate, SDBS), and using water as the synthesis solvent. Transmission electron microscopy (TEM), X-ray diffraction (XRD), Fourier transform infra red spectroscopy (FTIR), and UV-visible absorption are utilized to characterize the Ag-Ni nanoparticles. The surface plasmon resonance peak (SPR) of CTAB capped Ag-Ni and SDBS capped Ag@Ni located at 230 nm and 395 nm wavelengths, respectively. The UV-visible spectra show that the optical properties of Ag-Ni could be tuned by changing the employed stabilizer. The time resolved spectra of CTAB capped Ag-Ni shows a red shift to ca. 425 nm indicate the deposition of metallic silver on the surface of Ni. The effect of SDBS and CTAB on morphology of Ag-Ni NPs is discussed in detail. The synthetic method reported here suggests a very promising use of the suitable stabilizer for the preparation of bimetallic nanoparticles having different optical properties, which is a subject of immense interest.

Key words: Seedless; Ag-Ni; CTAB; SDBS;

Imaging of the optical response of single nanoparticle spatially oriented and shaped by ion irradiation

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Abstract:

During the last decade, many efforts have been made to develop techniques for the integration nanostructures in functional matrices. This activity, mainly boosted by advances in nanofabrication techniques, has enabled the development of elegant methods for the development of planar nanodevices. However, the design and implementation of embedded three-dimensional (3D) nano-architectures with tunable spatial orientation remains a challenge. To overcome this difficulty, an alternative is offered by the technique of sculpture using ion beam (ion-beam shaping). We used this method to produce an array of embedded gold anisotropic and spatially oriented in a silica matrix. It is clear that the flexibility given by the ion-shaping technique allows to fabricate "à la carte" 3D configurations of nanostructures.

For this study we have performed double purposes. First, we used the ion-shaping method to produce an array of embedded gold anisotropic particles (nanorods and nanowires) and spatially oriented in a silica matrix (see Figure 1). On the other hand, we invistigate those individual 3D anisotropic and orientated particles using a non-linear microscope based on second-harmonic generation (SHG). A tightly focused linearly or radially-polarized laser beam is used to excite nanoparticle with different orientations. In fact, the cylindrical vector beams, which offer unprecedented opportunities for controlling the vectorial field in the focal volume, is used in order to effectively excite oriented nanoparticles.

We report the high sensitivity of the SHG response to the anisotropic particles orientation under different states of polarization when the titled angle of the particle is changed. More specifically, the second-harmonic signals obtained for linear and radial polarizations correlate well with the orientation of the nanoparticle. These features arise from variations in the local state of polarization in the focal volume, because resonantly-excited SHG relies on the field component along the long axis of the particles. Also, the experimental results were obtained to be in very good agreement with simulations based on the boundary-element method.

Compared with previous reports, our results provide a considerable improvement for understanding the interaction of highly focused beams with anisotropic sub-wavelength structures.

Keywords: Ions Irradiation, gold nanoparticles, plasmonics, nonlinear microscopy, second-harmonic generation.

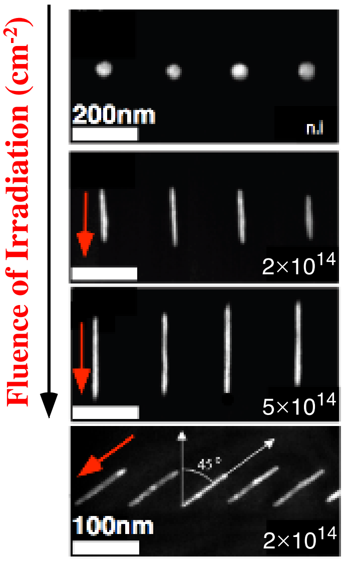

Figure 1: Ion-shaping of an array of gold nanoparticles embedded within a silica matrix. (a) Array (with a pitch 200 nm) of as-prepared gold nanoparticles (diameter of 30 nm) within a 200 nm silica matrix. (b–d) HAADF cross-sectional images showing the morphological deformation of the nanoparticles with fluence: (a) spherical, (b) nanorod (NR) and (c) nanowires (NW). The labels indicate the ion fluences in units of ions. cm−2, with the tag (n.i.) referring to the non-irradiated sample. The red arrows indicate the direction of the ion beam. (d) HAADF cross-sectional image of NR fabricated using an ion beam at an irradiation angle of 45° and a fluence of $2{*}10^{14}$ ions/cm^2. The tilted NR has the same dimensions as the vertically aligned NRs.

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Ammonia sticking on surfaces

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Abstract:

Gas seeding is often used in tokamaks to reduce the power load onto the divertor target plates. Specifically, nitrogen is the preferred seeding species because of its favorable radiative properties as well as its apparent beneficial effect on plasma confinement [1].

However, nitrogen molecules are chemically reactive with hydrogen and its isotopes to form stable ammonia compounds. In the ASDEX-Upgrade tokamak, nitrogen to ammonia conversion rates as high as 8% were measured [2] and evidence of similar ammonia production has also been obtained in JET-ILW operation [3]. The formation of tritiated ammonia in ITER, should nitrogen be used as a radiative species in the divertor, poses several potential issues. Amongst them are the retention of tritiated ammonia on the active charcoal used in the divertor cryo-pumps and the need for high temperature regeneration to fully recover ammonia. In addition, since ammonia is a polar molecule it can easily stick on metallic surfaces and contribute to the in-vessel T retention. It is therefore important to understand the sticking of ammonia on different surfaces. In this contribution, we present a comprehensive investigation of the effects of ammonia gas pressure and surface composition on the adsorption/desorption process.

Ammonia interaction with W, stainless steel (SS), B, Be/BeO and Au surfaces was studied at different pressures in the range of 10-4 to 800 mbar. The different metallic layers were deposited by magnetron sputtering on a quartz crystal microbalance (QMB) surface. The ammonia gas was then introduced and regulated until a constant pressure is reached. Ammonia molecules sticking on metallic surface were registered using the QMB.

For all used materials the NH3 sticking was increasing as a function of pressure and no saturation was seen up to 800mbar. Furthermore, the NH3 interaction with the surface is stronger for a W, SS and B surface compared to Au and Be surface. This is due to the dissociative chemisorption of the molecule and formation of stable compounds on these surfaces. In fact, NH3 sticking proceeds through multilayer adsorption procedure. The first monolayer results from a chemisorption process involving the nitrogen lone pair and the partially empty orbitals of the metals and the following layers stuck through H bonds. The quantity of adsorbed ammonia depends on the electronic structure of the surface metal i.e on the number of available orbitals of the metal. Finally, XPS results show the formation of surface nitrides through the dissociation of NH3 to NH2, NH and then N on B, SS and W surface. While for Au and Be no nitrogen-metal bond was detected.

Keywords: nuclear fusion, plasma-wall interaction, , nitrogen seeding, ammonia, catalysis, X-ray photoelectron spectroscopy (XPS), quartz crystal microbalance (QMB)

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Design of Lubricating Compositions Based on Nanoscale Potassium Polytitanates Modified by Transition Metals

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Abstract:

The heterostruct nanopowders were produced by treatment of layered nanoscale particles of the amorphous potassium polytitanate (PPT) in aqueous solutions of some transition metal salts (Me = Zn, Cu, Ni, Mn, Co, Cr, Fe) [1] and used as lubrication oil additives. It was recognized that the obtained products were represented with platelet PPT particles partially intercalated by Me^{n+} ions and decorated with MeO_y nanoparticles. An influence of these nanopowders on tribological properties of some model greases, based on #20 machine oil as well as commercial grease of Litol-24 Russian trademark containing different admixtures of the synthesized nanoparticles, were investigated by standard four-balls machine testing method (ASTM D2783). The nature of high antifriction, antiscuff and antiwear properties of the obtained lubricating systems was considered taking into account the data of structural investigation. It was shown, that high antiwear properties of the surfaces lubricated with modified PPT particles could be explained by lamellar structure of the PPT particles as well as incorporation of Ti and Me into the surface layer of lubricating material (Figure 1) supporting moderately increased micro-hardness of the steel as well as improved elastic properties. The best tribological performance was achieved with the additives consisting of PPT particles treated in the aqueous solutions of Zn sulphate. At the same time the best improvement in nonseizure loading was obtained with the heterostructured particles based onPPT modified in the mixture of Zn and Al sulphates. The obtained results were used to prepare main principals wich allow to formulate optimal compositions of nanoscale lubricating additives.

Keywords: modified potassium polytitnate, heterostructured nanoparticles, antifriction and antiwear properties.

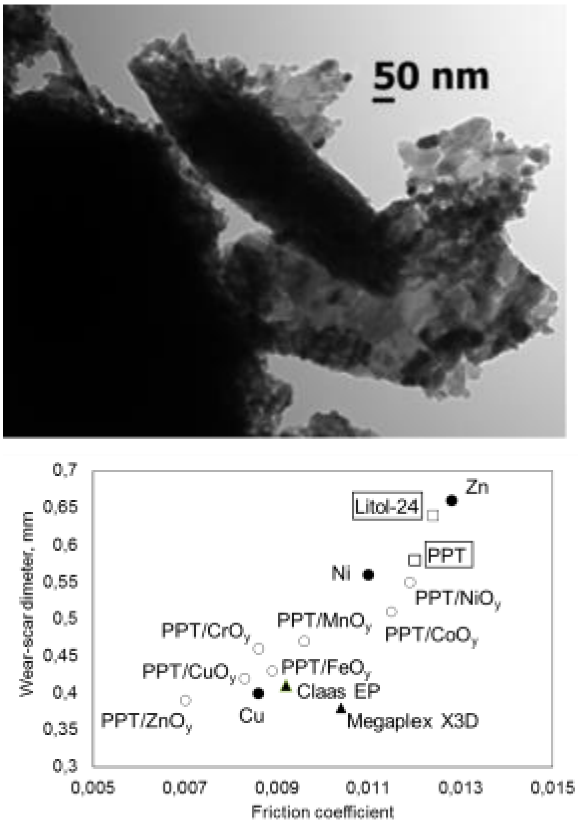

Figure 1: Figure illustrating the morphology of modified PPT powders (system PPT/NiO_x) and tribology properties of lubricating compositions based thereon in comprion with some commersial greases and nanoscale particles of different metals.

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Alkanolamine functionalized N, S co-doped reduced graphene oxide for high performance supercapacitor application

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Abstract:
Graphene has attracted worldwide attention in the areas of sensors, catalysis, fuel cells and energy storage materials due to its remarkable physicochemical properties [1]. Among energy storage materials, supercapacitors have attracted substantial research interest because of their high power density, fast charging/discharging, long cycling stability, low cost and outstanding safety [2]. However, the unavoidable restacking of graphene sheets during the chemical reduction process deteriorates its electrochemical performance. Therefore to overcome this problem, researchers have doped the graphene with heteroatoms (N,S, P and B) which results into improved capacitance and electrical conductivity [2]. Despite these merits, it has been observed previously that the doping reduces the surface area of graphene sheets due to the restacking phenomenon [3]. It is believed that the functionalization/modification of doped graphene surface with hydrophilic molecule can modulate the surface chemistry with improved surface area and wettability. We report the functionalization of N, S co-doped reduced graphene oxide (rGO) by alkanolamine molecules which provides more stabilized graphene structure with improved surface area. Interestingly, the synergistic effect of alkanolamine functionalization and co-doping in rGO resulted in impressive electrochemical performance with a high specific capacitance value (490 F/g at 1 A/g), excellent cycling stability (10,000 cycles at 20 A/g), high coulombic efficiency (99.5 – 100%), and high energy/power density (43.55 Wh/kg/400 W/kg). These features suggest the potential of as synthesized electrode material for high performance supercapacitor application.

Keywords: Reduced graphene oxide, co-doping, Functionalization, Improved capacitance, supercapacitors.

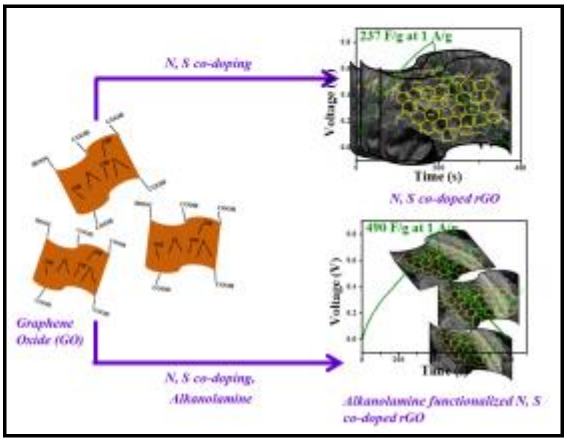

Figure 1: Figure illustrating the formation of N, S co-doped rGO and its functionalization with alkanolamine molecules with its electrochemical performance.

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Microanalysis of Interfacial Tranzition Zone between Surface Modified Polymeric Fibers and Cement Matrix

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Abstract:

As has been mentioned many times, a surface of most of polymeric fibers (e.g. polyethylene terephthalate, polypropylene, polyethylene, etc.) used as reinforcement in any composite materials can be described as smooth and rather hydrophobic. These surface parameters are responsible for difficult both the chemical and the physical interaction with different composite continual phases, namely with the inorganic matrixes like cement or lime-based binders (both containing water qua polar liquid). This phenomenon is perceptible in the field of cement composite materials. The unsatisfactory chemical interaction between the fibers and cement matrix results on a poor bond and even on an estimation of porous areas in the interfacial transition zones (ITZ). It is obvious that thus created ITZ does not allow an effective stress transport from the matrix to the reinforcement. A principle of a synergic interaction between composite phases is thus no guaranteed. To eliminate the mentioned phenomenon, fiber surface treatment can be applied. There are a few ways based on chemical (surface activation and etching) and physical (roughening) treatment. Plasma treatment seems to be an effective alterative to modify polymer fiber surfaces from hydrophilic to hydrophobic and thus to ensure the requierd strong bond to the cement matrix. To the end, we modified polymer macro-fibers using a low-pressure oxygen cold plasma. Subsequently, we made cement samples reinforced with the treated fibers, while we focused on the properties of the ITZ. Mechanical parameters of the ITZ was examined using nanoindentation, while its chemical composition was investigated by SEM phase analysis. It was pointed out, that both the mechanical and the chemical parameters of the ITZ (between modified fibers and the cement matrix) were improved when compared to reference samples.

Keywords: polymeric fiber, fiber reinforcement, surface modification, plasma, hydrophilic surface, interfacial transition zone, cement matrix, microanalysis, nanoindentation.

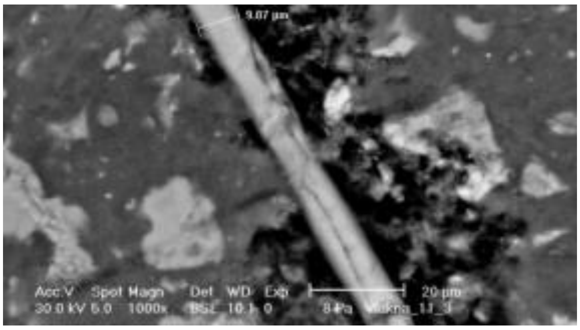

Figure 1: SEM image simply illustrating porous structure in the interfacial transition zone between PET fibers and cement matrix: the black areas showing pores around the fiber created due to hydrophobic fiber surface. Our endeavor is to avoid the pores estimation between the two materials using fiber surface activation.

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Interaction Enhancement between Glass Micro-fiber Reinforcement with Cement and Lime-based Matrix

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Abstract:
Mechanical performance of the fibrous composite materials can be increased, in general, by three different ways: (i) by a manipulation of an individual phases amount, (ii) by a mechanical properties increase of individual phases and (iii) by a manipulation with interface interactions between the phase of the reinforcement and the matrix. In the civil engineer praxis, where the fibrous composite materials based on silica matrixes (lime-based or cement) are used frequently, a poor interaction between the matrix and fibres (especially glass) limit a potential of those materials. Both the chemical and the physical interaction between the two phases play an important role in the mechanical performance of the composites. Due to smooth and chemically inert fiber surfaces, the interaction between them and the matrix is insufficient. Therefore, we focused to the third way to improve a bond and an adhesion between glass fibers and the lime-based and the cement matrix. In order to improve surface properties of glass fibers, we treated them by the cold low-pressure coupled oxygen plasma having twofold impact – chemical (surface activation by active polar groups) and physical (surface roughening by ion bombardment). An effect of the executed treatment we examined by wettability measurements, SEM surface observations while the interaction between the two different matrixes and the treated fibers was tested indirectly – by four-point bending tests of reinforced prismatics specimens, where their behavior was observed and evaluated using DIC analysis as indicated in the Figure 1.

Keywords: glass micro fibers, micro fiber reinforcement, surface treatment, plasma treatment, wettability, interface interaction, cement matrix, lime-based matrix, fibrous composites.

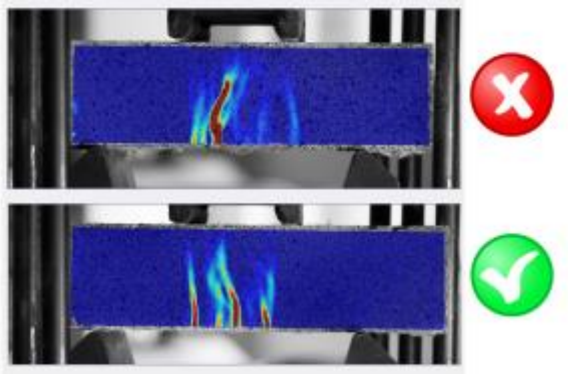

Figure 1: Figure illustrating two different behaviors of loaded fibrous cement-composite materials during a four-point bending test observed by the DIC analysis: at the top, there is shown an undesirable response characterized by a single-crack behavior referring to an insufficient interaction between the reinforcement and the matrix, meanwhile at the bottom, the figure shows a required multiple-cracking behavior of the samples.

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Nanotechnology trend analysis using Google Trend and Data Mining Method for NanoInformatics

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Abstract:

Our research is aimed at predicting recent trend and leading technology for the future and providing optimal Nano technology trend information by analyzing Nano technology trend. Under recent global market situation, Users' needs and the technology to meet these needs are changing in real time. At this point, Nano technology also needs measures to reduce cost and enhance efficiency in order not to fall behind the times. Therefore, research like trend analysis which uses search data to satisfy both aspects is required. This research consists of four steps. We collect data and select keywords in step 1, detect trends based on frequency and create visualization in step 2, and perform analysis using data mining in step 3. This research can be used to look for changes of trend from three perspectives. This research conducted analysis on changes of trend in terms of major classification, Nano technology of 30's, and key words which consist of relevant Nano technology. Second, it is possible to provide real-time information. Trend analysis using search data can provide information depending on the continuously changing market situation due to the real-time information which search data includes. Third, through comparative analysis it is possible to establish a useful corporate policy and strategy by apprehending the trend of the United States which has relatively advanced Nano technology. Therefore, trend analysis using search data like this research can suggest proper direction of policy which respond to market change in a real time, can be used as reference material, and can help reduce cost.

Keywords: Clustering, Data mining, Nano technology, Trend analysis

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Posters Session II:
Nanotech ME 2017 / Biotech ME 2017

Thermo-Electrochemical Cells for Low-Grade Waste Heat Conversion

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Abstract:

Low-grade waste heat (temperature gradient below 100 °C), from such sources as industrial thermally waste (heat of cooling towers, low-temperature elements of furnaces, chimneys, various heat carriers, etc.) and sustainable energy resource (geothermal activity and solar heating) [1] is wary promising energy sources. The original way for generating electricity using low-grade temperature gradients are thermo-electrochemical cells (TECC) [2,3].

A promising direction in fild of TECC is to create thin-layered electrochemical cells with interlayers of solid polymer or mineral electrolytes and working electrodes that are found at different temperatures.

The polymer gel based on polyacrylic acid and Zn based electrode was used to produce TECC in presented work.The operation of such thermoelectric devices is based on the electrochemical processes taking place at the interface of the composite electrolyte and metal /metal oxide electrode and is determined by difference between electric potentials of the electrodes at different temperatures.

The voltage generated of TECC at different temperature is shown in Fig. 1.

A value of hypothetical Seebeck coefficient of the prepared thermoelectric systems was calculated: $S = \partial V / \partial T = 2{,}3\text{-}1{,}5$ mV/°C.

Keywords: thermo-electrochemical cells, low-grade waste, polymer electrolytes, seebeck coefficient.

Acknowledgments: This research was financially supported by the Ministry of Education and Science of the Russian Federation (project 10.1434.2017/4.6).

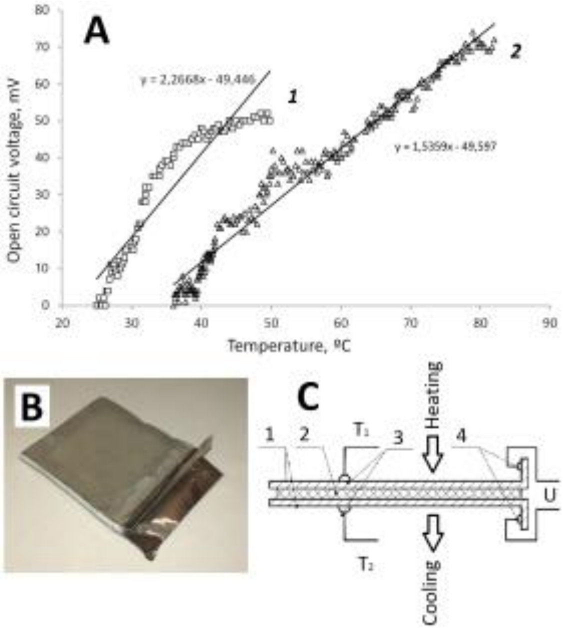

Figure 1: The open circuit voltage for TECC (A). Prototype of TCC (B). Measuring prototype scheme: 1 – Electrodes, 2 – Hydrogel, 3 – Thermocouples, 4 - Voltage measurement.

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Enhanced self-cleaning performance of Ag-F-codoped TiO_2/SiO_2 thin films

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Abstract:
Titanium dioxide (TiO_2) has become the most promising candidate that find extensive application in the field of self-cleaning, photocatalysis, phototovoltaics, pigments, antibacterial and hydrogen production. In this study, highly self-cleaning thin films of TiO_2-SiO_2 co-doped with Ag and F have been prepared by sol-gel method. The as-prepared thin films consist of bottom SiO_2 and top TiO_2 layers which are modified by doping with F, Ag and F-Ag elements. The fabricated thin films were characterized by X-ray diffraction (XRD), UV-Vis spectroscopy, scanning electron microscopy (SEM), transmission electron microscopy (TEM), and X-ray photoelectron spectroscopy (XPS). XRD analysis confirmed that the prepared thin film was a crystalline anatase phase. The self-cleaning properties of the prepared films were evaluated by a water contact angle measurement under UV light irradiation. Fig.1 shows the variations of contact angle for four different films, (pure TiO_2, Ag-doped TiO_2, F-doped TiO_2, F-Ag-doped TiO_2)/SiO_2 with irradiation time. Before UV light irradiation, the nature of thin films was hydrophobic and the water contact angles of all thin films were in the range of 21-24°. After UV light irradiation the water contact angle decreased to about 4° within 5 min to be super-hydrophilic. Self-cleaning performance of the Ag-F-TiO_2/SiO_2 thin film was higher than other samples of (pure TiO_2, Ag-doped TiO_2, F-doped TiO_2)/SiO_2 under both UV and visible light. This higher self-cleaning performance of the Ag-F-doped TiO_2/SiO_2 thin film was mainly attributed to the synergetic effect of F and Ag dopants, which help to create oxygen vacancies and facilities the separation of electron-hole pairs.The photocatalytic performance of thin films were studied using methylene blue dye under both UV and visible light irradiation. The Ag-F-doped TiO_2/SiO_2 thin film exhibited higher photocatalytic activity under both UV and visible light compared to other samples.

The double layered thin films of F-Ag-doped TiO_2-SiO_2 are plausibly applicable for developing self-cleaning materials in various applications such as windows, solar panels, cements, and paints.

Keywords: Titanium dioxide, Ag-F-TiO_2/SiO_2, self-cleaning, photocatalytic, visible light.

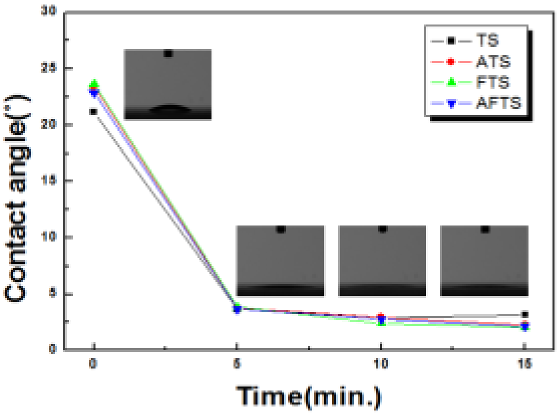

Figure 1: Contact angle variations of (TiO_2, Ag-TiO_2, F-TiO_2, Ag-F-TiO_2)/SiO_2 under UV light irradiation.

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Photocatalytic decolourization of (2-((10-decyl-10H-phenothiazin-3-yl)methylene)malononitrile) by ZnO and TiO_2 nanoparticles

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Abstract

Nanoparticles of the commercially available ZnO and TiO_2 show efficient water remediation in terms of decolourization of organic dyes. In this work, the photocatalytic performance of ZnO and TiO_2 nanoparticles were tested the photocatalytic decolourization of the home-made 2-((10-decyl-10H-phenothiazin-3-yl)methylene)malononitrile dye in aqueous medium under the illumination of UV black light. The obtained results showed that the activity of TiO_2(P25) is better than that of ZnO. The decolourization profiles were fits perfectly with the first order kinetic and the rate constant was calculated. Moreover, the stability of the applied photocatalysts was also investigated.

Keywords

Phenothiazine; Photocatalysis ; Photocatalytic degradation; TiO_2; ZnO

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Study of visible light sensitive CeO_2 incorporated mesoporous TiO_2 photocatalyst

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Abstract:

Mesoporous titanium oxide (MS-TiO_2) is synthesized by a combined and modified sol-gel and hydrothermal routes. MS-TiO_2 is impregnated with different concentrations of CeO_2 (cerium oxide) to enhance the quantum efficiency under visible light. TiO_2 and CeO_2/TiO_2 nanocomposites have anatase phase as major crystalline form having variation in crystal size. TEM images of 2.0 % CeO_2/TiO_2 composite in Figure 1 exhibits mesoporous structure. The sample has aggregation of nanoparticles in the mesoporous range with particle sizes in the range of 10-20 nm. Mesoporous CeO_2/TiO_2 nanocomposites show response toward visible light absorption due to the charge transfer between the TiO_2 valence or conduction band and the cerium ion (Figure 2). The effect of cerium ion incorporated into TiO_2 is similar to adding a photo sensitizer to the reaction solution The band gap of CeO_2/TiO_2 nanocomposites is significantly decreased due to the presence of Ce-O-Ti linkages which are confirmed by Fourier transform infra-red (FTIR) and X-ray photoelectron emission spectroscopy (XPS). The samples incorporated with 2.0 % of CeO_2 show superior photo catalytic activity as compared to pure TiO_2 and other nanocomposites due to mesoporosity, low band gap and Ce-O-Ti linkages (Figure 3).

Keywords: mesoporous titania; ceria; new linkage; nanocomposite, wet impregnation

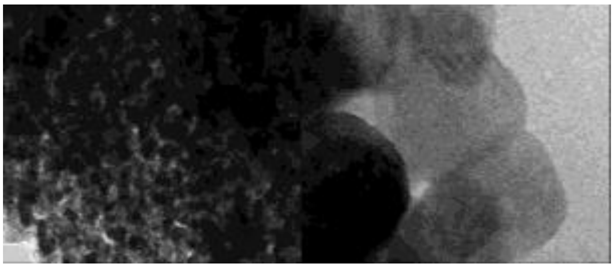

Figure 1: TEM images of mesoporous 2.0 % CeO_2/TiO_2 nanocomposites (a) and HRTEM image (b)

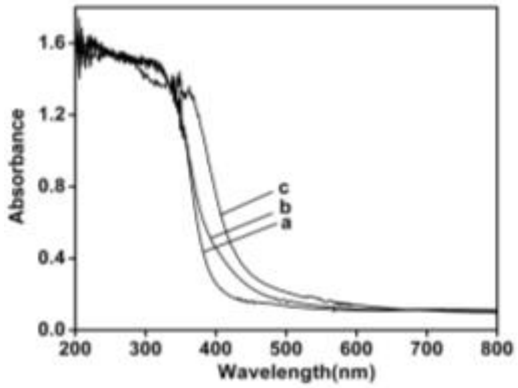

Figure 2. DRS patterns of different samples (a) pure titania (b) 2.0% CeO_2/TiO_2 (c) 3.0% CeO_2/TiO_2.

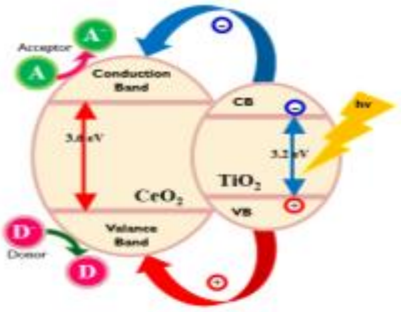

Figure 3. Mechanism of degradation of organics by CeO_2-TiO_2 nanocomposite

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Tin Oxide Nanoparticles Deposited by MAPLE for Conductometric Gas Sensors

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Abstract:

This paper reports on the deposition of tin oxides nanoparticles thin films by MAPLE (Matrix Assisted Pulsed Laser Evaporation) for use as conductometric gas sensors. First gas sensors based on SnO_2 were developed by Naoyoshi Tagouchi in 1968; the importance of this material for gas sensing applications grew according to the needs of improved gas detecting sensibility and variety. The target was obtained by freezing a solution of tin oxide nanoparticles obtained by Laser Pyrolysis using tetramethyl tin and ethylene combined with an oxidized atmosphere as reactive gas mixture. Two types of nanopowders samples have been selected: the first contains mainly tin(II) oxide whereas the second contains mainly tin(IV) oxide. The as prepared samples were also thermally treated at 300^{0}C for 3 hours in order to decrease the proportion of the SnO phase. One of the thermally treated powders exhibits an almost pure SnO_2 phase as determined from the XRD pattern. The resulted thin films were analyzed by X-Ray diffraction, Atomic Force Microscopy and Scanning Electron Microscopy for structural and morphological properties; preliminary electrical tests were conducted and the results show good capability for hydrogen detection.

Study of the estimation of inhibitory efficiency in the pipeline corrosion prevention. Case of Hassi-Messaoud

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Abstract:

In the oil industry and especially in the oil refining, the internal corrosion of the pipelines made out of carbon steel (API 5L gr.B) is a well known phenomenon and constitutes a serious problem. The aim of this work is to study the interaction of the organic inhibitor commercialised under the name of CHIMEC 1038 with the siderite deposit formed on the surface steels of pipelines at the Hassi Messaoud refining plant. Thus, during the refining process, the presence of Carbon dioxide will generate a corrosion product in the form of an insulating iron carbonate film acting as a passivator. However, the field of existence of this deposit depends on the medium pH, and its deterioration will induce even more dangerous corrosion. In this work, gravimetric and electrochemical tests in the absence and presence of the inhibitor were carried out in order to evaluate the inhibitory efficiency of CHIMEC 1038 against the corrosion of hydrocarbon pipelines (figure 1).

Keywords: Corrosion, corrosion inhibitor, CHIMEC 1038, polarization, Pipeline cleaning chemicals.

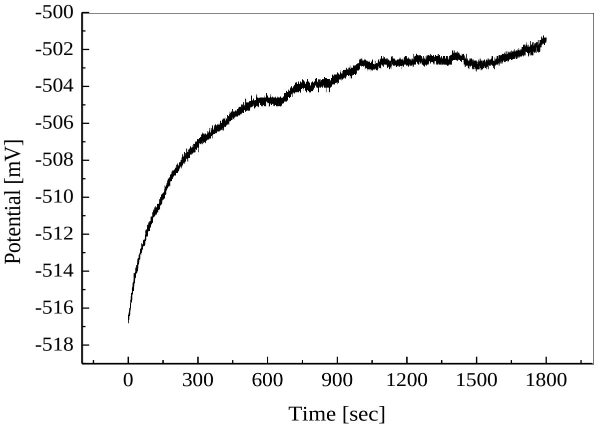

Figure 1: Figure illustrating the evolution of potential abandonment of API 5L Gr B steel in 1 M HCl..

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G-quadruplex-based luminescent probe and graphene oxide biosensor for RNA virus detection

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Abstract:

A molecular diagnostic method is one that can prevent the spread of these diseases and support treatment. Among them, point-of-care detection is a field that has attracted much attention due to its on-site applications. These techniques currently require complicated sample preparation steps and techniques and time. Sensitivity and selectivity are important concerns, especially in samples with fragile nucleic acids, such as RNA viruses. Granphen oxide (GO) is emerging as a useful material for biomolecule measurement because of its ability to adsorb biomolecules on the surface with excellent capability. The adsorption power between the GO and the nucleic acid has the ability to distinguish between double strand and single strand based on the difference in attraction between the type of strand and the GO surface. In this study, we developed an innovative method that can detect single-stranded RNA viruses in less than 15 minutes without the use of complex analytical machines and power. (Figure 1). In this method, graphene coated beads have two functions. It can lysis the RNA virus and extract the RNA, and create a sensing platform for horseradish peroxidase-mimicking DNAzyme probes to carry out colormetric detection when it becomes hybrid with the extracted complementary RNA virus. We chosen Murine norovirus, which causes epidemic gastroenteritis worldwide, as a model virus for single-stranded RNA detection. As a result, this study enabled rapid measurement of model sequences mimicking viral RNA sequences, with a wide detection range (lower detection limit = 125 nM) and with the naked eye. This methods helps to develop in field of point-of-care diagnosis by providing highly selectivity, cheap, and simple procedure, outside laboratory conditions.

Keywords: G-quadruplex, Graphene oxide, Bead-beating method, HMDNAzyme, MNV, ssRNA detection, Colorimetric detection

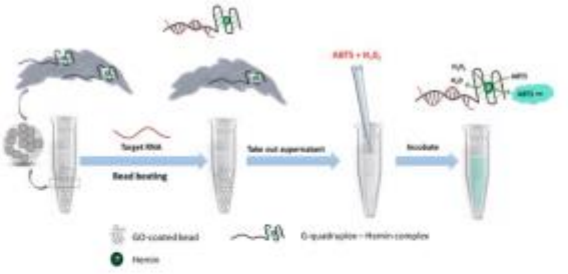

Figure 1: Schematic illustration of colorimetric RNA detection based on the discrimination ability of graphene oxide (GO) towards single-strand DNA and RNA:DNA duplexes. In the presence of the G-quadruplex–Hemin complex, the ABTS/H_2O_2 solution generates a typical absorption spectrum of ABTS+, being 2.5-fold higher than that generated from pure hemin, indicated by the darker green color solution.

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Preparation and Characterization of Cerium Oxide Nanoparticles for Biomedical Applications

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Abstract:
Along with the availability of different treatment methods for cancer type and stage, the number of studies for the use of nanotechnology products has increased rapidly in recent years. One of the most important causes that trigger cancer formation and affect cancer treatment is reactive oxygen species (ROS) that are the result of metabolic activities in cells (1). In the diagnosis and treatment of the cancer tissue nanoparticles that can be prepared from different materials can be used Cerium oxide nanoparticles (CNP-CeO_2 nanoparticles), with their high catalytic activity, are very interesting nanomaterial that finds numerous applications in various fields such as solid oxide fuel cells, polishing agents, gas sensors (2). Research has provided interesting data indicating that this material may show antioxidant effects in tissue culture cells. In addition, in some studies CeO_2 nanoparticles have been shown to reduce radiation toxicity of normal cells during radiotherapy applications, thereby increasing both therapeutic efficacy and protecting healthy cells (3).

The preparation, characterization and determination of cytotoxicity of CNPs with antioxidant properties are among the objectives of the study. For in vitro studies, the MDA-MB-231 breast cancer cell line was selected as the target cell. In the literature, although the antioxidant properties of CNPs are tested on various cell lines, studies with breast cancer cell lines are inadequate. With these studies, it is aimed to eliminate the deficiencies in this area. In the study, we synthesized and characterized the CeO_2 nanoparticles via solution combustion method using ceric ammonium nitrate as an oxidizer and ethylenediaminetetra acetic acid (EDTA) as a fuel.

Characterization studies were carried out after CNPs were prepared. Dimensional analysis of CNP is characterized by using TEM (permeable electron microscope); the surface charge is determined by X-ray diffraction and the crystallinity is measured by XRD. According to the results from TEM images, the dimensions of CNPs are between 40-60 nm (Figure 1). After the characterization studies of the nanoparticles were completed, the cytotoxicity of the nanoparticles at different concentrations was determined on the MDA-MB-231 breast cancer cell line depending on the duration of incubation.

Keywords: Cerium oxide nanoparticle, Breast cancer, MDA-MB-231.

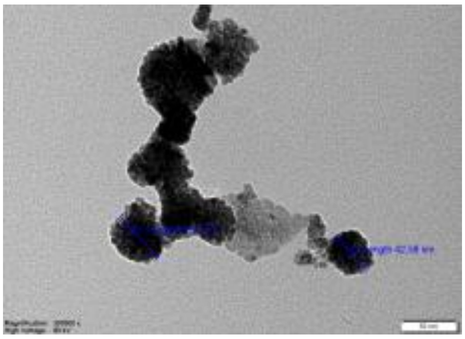

Figure 1: TEM images of CeO_2 nanoparticles

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Optical Glucose Sensors Based on Imprinted Nanopatterns in Hydrogel System

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Abstract:
Hydrogel-based systems have emerged as a reusable sensing platform to quantify biomarkers in high-risk patients at clinical and point-of-care settings. The capability to integrate hydrogel-based systems with optical transducers will provide quantitative and colorimetric measurements via spectrophotometric analyses of biomarkers. Here, we created an imprinting method to rapidly produce 2.5D photonic concavities in phenylboronic acid functionalized hydrogel films (Figure 1). Our method exploited diffraction properties of a hexagonally-packed 2.5D photonic microscale concavities having a lattice spacing of 3.3 µm. Illumination of the 2.5D hexagonally-packed structure with a monochromatic light source in transmission mode allowed reversible and quantitative measurements of variation in the concentration of glucose based on first order lattice interspace tracking. Reversible covalent phenyboronic acid coupling with cis-diols of glucose molecules expanded the hydrogel matrix by ~ 2% and 34% in the presence of glucose concentrations of 1 mM and 200 mM, respectively. A Donnan osmotic pressure induced volumetric expansion of the hydrogel matrix due to increasing glucose concentrations (1-200 mM) resulted in a nanoscale modulation of the lattice interspace, and shifted the diffraction angle (~ 45° to 36°) as well as the diffraction orders (~ 8 to 3 mm). The sensor exhibited a maximum lattice spacing diffraction shift within a response time of 15 min in a reversible manner. The developed 2.5D photonic sensors may have application in medical point-of-care diagnostics, implantable chips, and wearable continuous glucose monitoring devices.

Keywords: Optical sensors, hydrogels, glucose sensing, phenylboronic acids, diabetes.

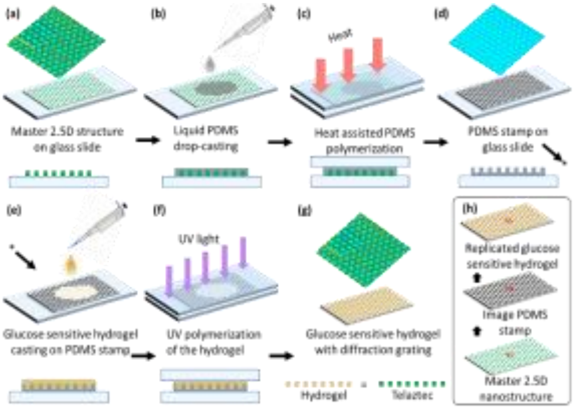

Figure 1: Schematic illustration of imprinting the micrograting on the glucose sensitive hydrogel: (a-d) preparation of PDMS stamp, (e-g) copying the structure from PDMS stamp on a glucose sensitive material and (h) summary of the replication process.

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Silk Protein Based siRNA Nanocarriers to be used in Larynx Cancer Therapy: Cellular Interactions Studies

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Abstract: Head and neck cancer (HNC) is one the most common cancer type in all over the world and among HNC types and larynx cancer as a HNC type cancer is the second leading respiratory system cancer after lung cancer [1-2]. Genetical approaches for the cancer therapy is one of the new generation therapeutic strategy by inhibiting directly the undesired gene's mRNA by using siRNA for the cancer cells to overcome the disadvantages of the conventional therapies (i.e., surgical and others). On the other hand siRNA has negatively surface charge (it's limited the transfection into the tumor cells) and it can be rapidly decompose by nuclease attacks [3]. Those characteristics limit the therapeutic use of siRNA in cancer treatment. Therefore, an effective and suitable carrier system is needed for the transportation of siRNA into the targetted tumor cells. Silk proteins are FDA approved materials being non toxic, biodegradable and having functional groups [4-5]. They are also commonly used as micro and nanoparticle forms for active ingredient delivery due to their high transfection ability and stability against to nuclease enzymes.

Novel silk protein based nanocarriers at various formulations were developed for small interfering RNA (siRNA) based gene silencing therapy for larynx cancer in this study. In the first part of the study; silk protein based nanocarriers (i.e., sericin-fibroin with or without albumin) were prepared (here certain amount of sericin, fibroin, albumin, sericin-albumin or fibroin-albumin were dissolved in water and after adjusting pH to 7-9, acetone was added until the solution became turbid then glutaraldehyde solution (8% v/v) was used as crosslinker and the mixture was centrifuged/washed with distilled water to get the nanoparticles). Obtained nanoparticles were characterized with different techniques (i.e., SEM, FTIR, NMR, zeta sizer etc). According to the obtained results those nanoparticles were in the size range of approximately 120 to 1000 nm in diameter and their surface charges were changed between -15 to -42 mV. On the other hand optimization studies, the best formulation for the proposed siRNA carrying and targetting the tumor albumin-sericin nanopaticles (with the 2/1 mass ratio of Alb/Ser) were selected based on the physicochemical evaluations (Figure 1). In this part, also biodegradation and biocompatibility stdies were carried out and all nanoparticle formulations were defined as biocompatible. In the biodegradation studies Alb/Ser nanoparticles with 2/1 mass ratio seem so suitable for the proposed study.

In the second part; cellular interaction studies were realized with those nanocarriers by using Hep-2 cells to improve novel siRNA carriers to be used in larynx cancer therapy. For this purpose, first prepared nanoparticles were decorated with hyaluronic acid molecules for targetting the tumor cells selectively (here surface receptor of the tumor cells of CD44 was targetted and hyaluronic acid was decorated for binding the anti-CD44 molecules).

After this decoration procedure siRNA molecules (i.e., ASH2L, Cyclin D1 and CK2 siRNA) were loaded to the nanoparticles individually and they were interacted with the Hep2 cells for transfection process. The binding efficiencies were found in between around 35 to 60 % according to the initial siRNA concentration ratio. Finally, nanoparticles-tumor cells interaction studies show all CK2, ASH2L and Cyclin D1 siRNA loaded nanoparticles can suppress the tumorgenic expression *in vitro*. The results indicate that our novel nanoparticles have the potential of being an efficient vector as a siRNA carrier in larynx cancer therapy.

Keywords: larynx cancer, silk proteins, nanoparticles, siRNA therapies

Acknowledgments This study was financially supported by TUBITAK, 1001-Scientific and Technological Research Projects Funding Program. (Project No: 115R018)

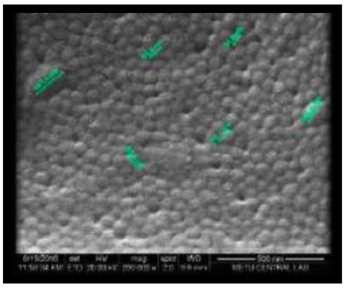

Figure 1. SEM Picture of Albumin-Sericin Nanoparticles with 2/1 Mass ratio

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Controlled protein corona orientation on the surface of nanoparticle and their influence on nanoparticle-cell interactions

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Abstract:

Nanoparticles (NPs) hold great potential for use in the field of therapeutic applications due to their unique size and physical properties. For this, their interactions this cell surface receptor have to be finelly controlled. So far, controlling specific interactions between NPs and cell surface receptors by immobilizing targeting protein had been elusive due to randomly adsorbed biomolecules from the biological fluids of dispersion. [1]. It is understood that randomly orientated immobilized proteins reduce the accessibility to their receptor binding domain leading to a low specific interaction of the NPs this the cell receptors and leading to non-specific NP internalization [2]. Therefore, to overcome the current issue we intend to form an artificial protein corona of apolipoprotein E (ApoE) with controlled orientation to influence a specific NP-cell membrane receptor interaction. In this purpose, the receptor binding domain of ApoE have been engineered to present only one cysteine residu in C terminal or in N terminal. The NPs surface was functionalized with orientated ApoE by grafting via the selective thiol-maleimide chemistry using a polyethylene glycol (PEG) linkers and thus controlling the orientation of the two engineered ApoE at the surface of the nanoparticles. Exposition and availability of the receptor binding site of immobilized ApoE have been evaluated by the mapping technic developed by CBNI, using antibody-labelled gold nanoparticles. Then, having two different receptor binding site exposision on the particles surface, we investigated the effect of this orientation on the NPs' binding affinity for the ApoE cell receptor.

Keywords: nanoparticles, protein orientation, protein corona, Apolipoprotein E, binding domain, polyethylene glycol, NP-receptor interactions.

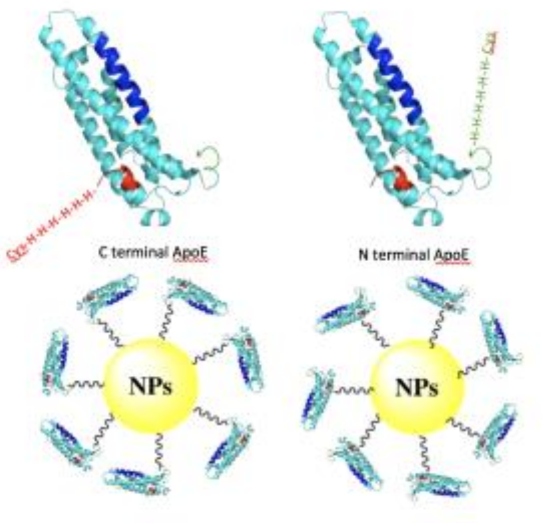

Figure 1. Schematic representation of two variants of engineered ApoE C and N terminal ApoE (top) and grafting in an orientated fashion to nanoparticles (bottom). the N terminal is shown in green colour, C terminal in red and receptor-binding area in blue.

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The role of CL-11, a recognition component of the lectin activation pathway of complement in pneumococcal infection

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Abstract:
The Lectin activation Pathway of complement (LP) is initiated by LP specific recognition molecules, i.e. MBL, CL-11 and ficolins. These subcomponents recognize a wide range of carbohydrates or acetylated structures on microbial surfaces and activate complement via the LP effector enzyme MASP-2. The essential role of the LP in fighting S. pneumoniae infections was first shown by Prof. Schwaeble's team using a mouse line deficient of MASP-2 and in mice deficient of the murine LP recognition component Ficolin A (Ali et al. 2012). This is the first report showing that CL- 11, an only recently identified recognition subcomponent of the LP, is critical in the innate immune defense against *S. pneumoniae* infections. My in vivo work was supported by numerous in vitro analyses using native and recombinant murine CL-11 which I produced ,revealing that this recognition subcomponent critically contributes to complement activation the surface of *S. pneumoniae*. So far, I compared the susceptibility of CL-11 deficient mice with that of sex-, age- and strain-matched wildtype control mice and this analysis revealed a dramatically increased mortality in CL-11-/- mice with a significant increase of *S. pneumoniae bacteraemia.*

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Screening of lytic phages against multi-drug resistant uropathogenic *Escherichia coli*

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Abstract:
Escherichia coli is one of the opportunistic pathogens in the hospitals. This pathogen is one of the common causes of diarrhea, urinary infections and other diseases such as sepsis, gastroenteritis and neonatal meningitis. Therefore, it is a potential target for investigating bio-therapeutic phages. Increasing attention to develop alternative antimicrobial agents for *E. coli* has been reported throughout the world. Natural sources are of great importance, particularly phages which are cost effective and safe. Bacteriophages are viruses that eliminate the susceptible bacteria selectively. Proliferation of lytic phase leads to bacterial lysis. Subsequently bacteria became more sensitive to antibiotics and for that, phages are also used as auxiliary treatment for synergistic properties.

In our study, we isolated two effective phages from environmental resources to lyse the clinically isolated *E. coli* from urinary tract infection (UTI) patient. Spot tests and growth inhibition assays were performed and sensitivity of bacteria to different MOI of phages was evaluated. Clear inhibition zones demonstrating the efficiency of phages against resistant bacteria observed. According to our results, isolated phages inhibited the growth of uropathogenic *Escherichia coli*, resistant to most of the commonly prescribed antibiotics. In this context, further studies on combination therapy involving both bacteriophages or their use with antibiotics would provide more details.

Keywords: bacteriophage, *Escherichia coli*, drug resistant, urinary tract infection

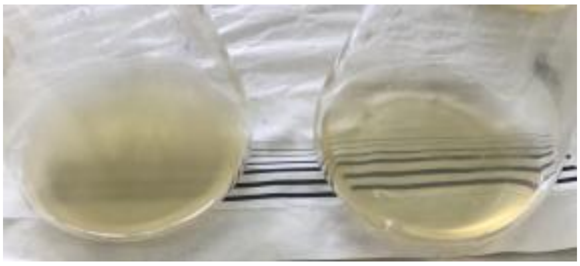

Figure 1: Figure illustrating the phage effect lyse the clinically isolated *E. coli* from urinary tract infection (UTI) patient.

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Quantitative force measurements using amplitude modulation force spectroscopy: Application to soft-matter

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Abstract:

The evolution of atomic force microscopy (AFM), in last decades, is characterized by the transition from a high spatial resolution technique able to image surfaces down to atomic scale, to a method that provides spatially resolved maps of mechanical, surface, and chemical properties. The simplest and most common technique used for quantitative force measurements involves directly monitoring the deflection of a static cantilever, from which the force is derived using Hooke’s law. However, this static technique, called contact mode, suffer from “jump-into-contact” instability when the cantilever is brought in surface vicinity, restressing its use to quantify short range attractive forces. Furthermore, the technique requires employing huge contact force that may damage the tip apex resulting in poor lateral resolution, or damaging the surface. The second effect is more important when probing soft matter such as polymer or biological materials. These limitations can be overcome using dynamic technique in which a cantilever oscillate at or close to its resonance frequency. Tapping mode AFM, also known as amplitude modulation AFM (AM-AFM) remains the most established nanoscale characterization methods of surfaces in air and in liquid environments. The principle of AM-AFM relies on detecting small changes in the cantilever amplitude and phase-shift when it oscillates at resonance frequency. These amplitude shifts can then be used as a feedback signal for nanometer (or atomic) resolution imaging. However, the measurable parameters such as the change in the amplitude or phase shift, do not correspond in a straightforward way to the interaction forces, as is the case in static “contact” mode. Here, we develop a force reconstruction method valid for any arbitrary drive amplitudes, for both conservatives and dissipative nanoscale processes. The method is based on assuming the tip-sample interaction as weekly perturbed harmonic oscillator, and applying the virial theorem in order to link the AFM observable quantities (amplitude and phase) to the tip-sample interaction forces Fts. The obtained formulas is inverted using certain mathematical tools including fractional calculus. The mathematical formulation of the force has been implemented numerically in MATLAB, and used to recover “numerically” the interaction forces from AFM observable. The validity of the model is investigated numerically in various configuration of tip radius and stiffness as well as various samples properties namely young modulus, surface tension and viscosity. In each case, the recovered force is compared to a theoretical force model: DMT model. The reconstruction model seems to give excellent results and is valid in both rigid samples and soft samples. The validity of the model is also discussed in presence of dissipating processes at nanoscale. This force reconstruction model will expand the capabilities of tapping mode AFM to enable a robust fast and accurate determination of mechanical, chemical and other surface properties of soft-matter nanomaterials.

Keywords: Atomic force microscopy, tapping mode, surface tension, mechanical properties, biological materials.

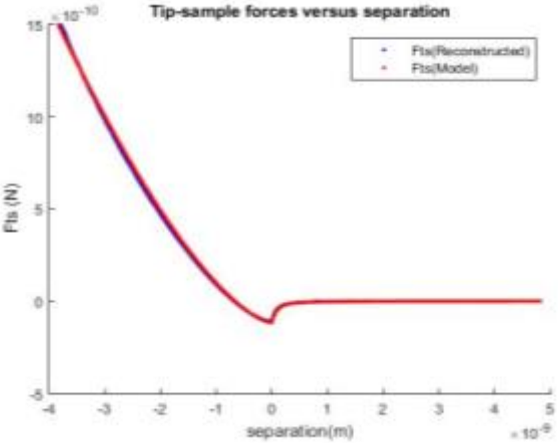

Figure 1: Figure illustrating the force reconstructed using mathematical model compared to the theoretical force model. The sample used is a soft material with young modulus of 100 MPa comparable to that of DNA or Polymer.

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Magnesium Silicates Nanoporous Materials For Removal of Organic Pollutants in Water

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Abstract:

Water pollution is a serious environmental problem in the current society. The utilization of nanostructured silicates in the treatment of organic pollutants in water is of perennial interest because of their low-cost and environmental friendliness [1] However, a potential disadvantage of these nanomaterials lies in that they are easily suspended and difficult to remove from water for recycling of adsorbents, which limits their practical application in wastewater treatment. Inspired by the easy sedimentation of 1D nanomaterials [2], nanoporous magnesium silicate nanoporous materials were investigated as an efficient adsorbents for organic pollutants in wastewater treatment Two Si precursors, inorganic (sodium silicate) and organic (tetraethoxy silane) were used to synthesize magnesium silicate (MgSil) nano materials [3]. The effect exerted by nature of Si pre-cursor on the morphology, structural and textural properties of MgSil samples was studied by different spectroscopy and N$_2$ adsorption, techniques. The characterization results show that MgSil-org sample pos-sessed hollow nanospheres which are com-posed of small platelets and sheets, in con-trast MgSil-inorg sample showed nanotubu-lar structure due to more alkaline nature of the inorganic Si precursor. Additionally, MgSil-org sample have different textural, acidic and basic characteristics. The adsorp-tion isotherm was obtained by varying the initial concentration of solution of meth-ylene blue (MB, as a model organic pollu-tant in the adsorption experiments) without any additives. The results indicating that 1 g of synthesized MgSil nanoporous materials can remove 185 mg g$_{-1}$ of MB, which is higher than that of natural sepiolite (58 mg g$_{-1}$) and coper silicate hierarchical hollow spheres (162 mg g$_{-1}$).

Keywords: magnesium silicate, nanoporous materials, methylene blue, spectroscopy, textural properties, water treatment applications.

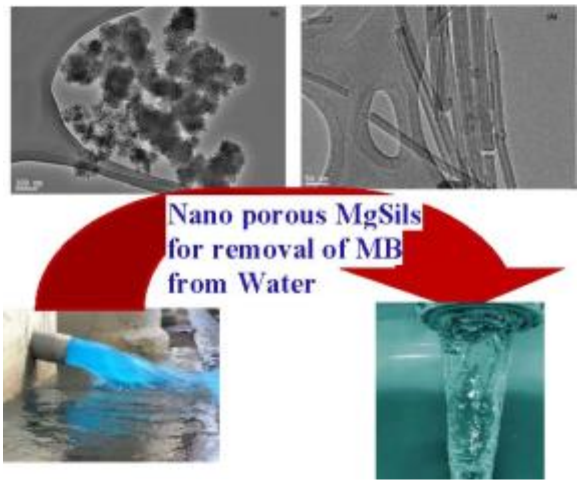

Figure 1: Figure illustrating the application of nanoporous magnesium silicate materials prepared from organic and inorganic precursors and application of materials for removal of methylene blue from the waste water

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