GAMS 2016

Nanotech Dubai 2016

Nanotech Dubai 2016 & GAMS 2016

International Joint Conferences

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Nanotech Dubai 2016 - GAMS 2016 Joint Conferences Preliminary Program

05 - 07 December, 2016 | Dubai, United Arab Emirates

December 5, 2016
Session I.A : Nanomaterials Fabrication, Characterization and Properties

Al-Safa 1&2 Conference Room

Session Chairs:
Prof. Suil In, Department of Energy Systems Engineering (DGIST), Rep. of Korea
Dr. Khaled Saoud, Virginia Commonwealth University in Qatar, Qatar

08:00-10:00	**Registration + Welcoming coffee**	
10:00-10:30	Synthesis and Characterization of Alginate-grafted Graphene Oxide S. Liu and **L. Li**	**Prof. Lin Li**, Nanyang Technological University, **Singapore**
10:30-10:45	Facile and large-scale Synthesis of High Quality Few-Layered Graphene Nanoplatelets via Methane Decomposition over Unsupported Iron Family Catalysts **A.E. Awadallah**, A.A. Aboul-Enein, U.F. Kandil and M.R. Taha	**Prof. Ahmed Awadallah**, Egyptian Petroleum Research Institute, **Egypt**
10:45-11:00	Effect of Film Thickness Variation on the Formation of Metallic Nanoparticles: Titanium Case **F.G. Alzubi**	**Dr. Feras Alzubi**, Kuwait Institute for Scientific Research, **Kuwait**
11:00- 11:30	Metal Oxide Nanomaterials Prepared in Morphology-Directing Agents	**Prof. Ali Bumajdad**, Kuwait University, **Kuwait**
11:30-12:00	Nanostructured Engineered Holographic Diffusers produced by high Throughput Extrusion Patterning V. Boerner, P. Johansen, J. Kafka, D. Kofoed, G. Kofod, T. Kraus, M. Matschuk, **J. Mick** and C. Stöver	**Dr. Jörg Mick**, Temicon GmbH, holotools, Freiburg, **Germany**
12:00-12:30	Electrochemical deposition of alkylphosphonic acid mono-layers on Nitinol A.Vanhoolanda, S. Devillersa, T. Issakovaa, C. Michauxb, J.Delhallea and **Z. Mekhalif**	**Prof. Zineb Mekhalif**, University of Namur, **Belgium**
12:30-12:45	Decoration of multi-wall carbon nanotubes with iron nanoparticles using IR irradiation **A. K. Bhakta**, S. Detriche, P. Martis, R.J. Mascarenhas, J. Delhalle and Z. Mekhalif	**Mr. Arvind Kumar Bhakta**, University of Namur, **Belgium**
12:30-14:00	**Lunch Break / Posters Session I**	

Session Chairs
Prof. Ali Bumajdad, Kuwait University, Kuwait
Prof. Taleb Ibrahim, American University of Sharjah, UAE

14:00-14:45	A wafer-Scale Bernal stacked Bilayer Graphene Film Obtained on a Cu(0.61 %at Ni) foil using atmospheric Pressure vapour Deposition. **N. Manyala** and J.M. madito	**Prof. Ncholu Manyala**, University of Pretoria, **South Africa**
14:45-15:00	Magnetoresistance and domain wall pinning in multisegmented nanowires **H. Mohammed**, H. Corte-León, Y. P. Ivanov , O. Kazakova and J. Kosel	**Mrs. Hanan Mohammed**, King Abdullah University of Science and Technology, Thuwal, **Saudi Arabia**
15:00-15:15	Synthesis of Silicon-Carbon Films by High-Frequency Deposition **A. Temirov**, I. Kubasov, N. Timushkin, R. Zhukov, M. Malinkovich and Y. Parkhomenko	**Mr. Alexandr Temirov**, National University of Science and Technology (MISiS), **Russian Federation**
15:15-15:30	TiO2- graphene gas sensor for the detection of CO2 **M. Kamel** and M. Al Ahmad	**Ms. Mayar Kamel** United Arab Emirates University, AlAin, **UAE**
15:30-15:45	New Information On Water Flow Inside Carbon Nanotubes Reveald by 2D NMR Correlation Spectroscopy **J. Hassan**, G. Diamantopoulos, L. Gkoura and G. Papavassiliou	**Dr. Jamal Hassan**, Khalifa University, **UAE**
15:45-16:00	Effects of types of reduction and optimization multilayer graphene oxide under the influence of Raman Laser Power **A. Perez**, L.G.P. Huaman, M. Lopez and A. Champi	**Mrs. Adela A.Perez Carreno**, Pontifical Catholic University, **Peru**
16:00-16:30	**Coffee Break / Posters Session I**	

Session I.B: Advanced Materials Processing		
Session Chairs: **Prof. Zineb Mekhalif, University of Namur, Belgium** **Dr. Khaled Saoud, Virginia Commonwealth University in Qatar, Qatar**		
16:30-17:15	Improvements in mechanical strength and thermal stability of injection and compression molded components in custom-built Poly Lactic Acids (PLAs) **M. Barletta**, P. Moretti, E. Pizzi, M. Puopolo, S: Vesco and V. Tagliaferri	**Prof. Massimiliano Barletta**, University of Rome Tor Vergata, **Italy**
17:15-17:30	Hydrophilic Polymer Brush Layers on Stainless Steel Using Multilayered ATRP Initiator Layer **J.E. Friis**, R. L. Meyer, K. Daasbjerg and J. Iruthayaraj	**Mr. Jakob Ege Friis**, Aarhus University, **Denmark**
17:30-17:45	Temperature- and Time Dependency on High Friction Poly(Styrene-co-Butyl Methacrylate) Coated Paper **C. Bjerremand**, J. Larsen, and M. Hinge	**Mr. Christoffer Bjerremand**, Aarhus University, **Denmark**
17:45-18:00	Hybrid joining of Aluminium 7075 T6 with Poly Ethylene Terephthalate (PET) and Poly Ethylene Terephthalate (PET)/Poly Ethylene Vinyl Acetate (PEVA) blends M. Barletta and **A. Gisario**	**Mrs. Annamaria Gisario**, Sapienza University of Rome, **Italy**

December 6, 2016
Session II.A: Nanomaterials for Energy / Nano electronics

Al-Safa 1 Conference Room

Session Chairs: **Prof. Daniel Choi, Masdar Institute, UAE** **Prof. Ncholu Manyala, University of Pretoria, South Africa**		
09:00-09:45	Nanostructures for energy generation and energy conservation **S.M. Bedair**	**Prof. Salah. M. Bedair**, North Carolina State University, **USA**
09:45-10:30	3-dimensional hybrid architecture with graphene and carbon nanotubes for energy storage applications W.A.Gill, E-H. Yang and **D. Choi**	**Prof. Daniel Choi**, Masdar Institute, **UAE**
10:30-11:00	**Coffee Break / Posters Session II**	
11:00-11:45	Single Crystals and Nanocrystals of Lead Halide Perovskites for Optoelectronic Applications	**Dr. Osman M. Bakr**, KAUST, **Saudi Arabia**
11:45-12:00	Flexible Poly(vinylidene fluoride-co-hexafluoropropylene) Nanocomposites filled with Ternary Nanofillers for Energy Harvesting **D. Ponnamma**, E. Alper, P. Sharma and M. A. AlMaadeed	**Dr Deepalekshmi Ponnamma**, Qatar University, **Qatar**
12:00-12:15	Rapid and efficient removal of fluoride ions from aqueous solution using a polypyrrole coated hydrous tin oxide nanocomposite **K. Parashar**, N. Ballava, S. Debnathb, K. Pillaya and A. Maitya	**Mrs Kamya Parashar**, University of Johannesburg, **South Africa**
12:30-14:00	**Lunch Break / Posters Session II**	
Session chairs: **Dr. Osman M. Bakr, KAUST, Saudi Arabia** **Prof. Salah. M. Bedair, North Carolina State University, USA**		
14:00-14:45	Magneto-electric Memory in Strain-mediated Multiferroic Nano-heterostructure N*(TbCo2/FeCo)-PMN-PT A. Klimov, N. Tiercelin, Y. Dusch, **V. Preobrazhensky**, P. Pernod, A. Churbanov and S. Nikitov	**Prof Vladimir Preobrazhensky**, Wave Research Center GPI RAS, **Russain Federation**
14-45-15:15	Single Nanowire Based Nanoelectromechanical Systems **D. Erts**, R. Meija, L. Jasulaneca, A. I. Livshits, J. Kosmaca, J D. Holmes and J. Andzane	**Prof. Donats Erts**, University of Latvia, **Latvia**
15:15-15:30	Hybrid Plasmonic-Photonic nanolaser **A. Belarouci**	**Dr Ali Belarouci**, Ecole Centrale de Lyon, University of Lyon, **France**
15:30-15:45	MBE Grown InAsSb Nanowire Photodetectors **A. Alhodaib**, M. Thompson, A.R.J. Marshall and A.Krier	**Ms Aiyeshah Alhodaib**, Lancaster University, **UK**

15:45-16:00	Bidomain ferroelectric crystals: novel actuators for nanotechnology **I. Kubasov**, S. Ksenich, A. Temirov, M. Malinkovich, A. Bykov and D. Kiselev	**Mr. Ilya Kubasov**, National University of Science and Technology (MISiS), **Russia**
16:00-16:30	**Coffee Break / Posters Session II**	
16:30-17:00	Multivalent electrolyte based V2O5/Activated carbon hybrid supercapacitors K. Solanki and **R.K. Guduru**	**Dr. Ramesh K. Guduru**, Lamar University, Texas, **USA**
17:00-17:15	Novel Positive Electrode Materials for Li and Na Ion Re-chargeable Batteries M.M.S. Sanad, D. Harbaoui, C. Rossignol, E.K. Hlil and S. Obbade	**Dr. Moustafa Sanad**, Central Metallurgical Research and Development Institute, **Egypt**

December 6, 2016
Session II.B: Nanomaterials for Water treatment and Environment

Al-Safa 2 Conference Room

Session Chairs:
Prof. Taleb Ibrahim, American University of Sharjah, UAE
Prof. Suil In, Department of Energy Systems Engineering (DGIST), Rep. of Korea

09:00-09:45	Advanced nanofibers for water treatment and desalination **R. Hashaikeh**	**Prof. Raed Hashaikeh**, Masdar Institute, **UAE**
09:45-10:30	Applications for Ultraclean Metals Nanofluids Innovative Green Technology & Industrial Unit for Nanofluids Productive Manufacturing S. Khagen Bose, Y. Choong Ma, **L. Kistersky** and V.Sadokhin	**Prof. Ludmila Kistersky,** Global Technologies Limited, **UAE**
10:30-11:00	**Coffee Break / Posters Session II**	
11:00-11:45	Application of Graphene, Carbon Nanotubes, and their Magnetite derivatives for the Removal of Heavy Metals and Oil from Produced and Industrial Wastewater **T.H. Ibrahim**, M.A. Sabri, and M.I. Khamis	**Prof. Taleb Ibrahim,** American University of Sharjah, **UAE**
11:45-12:00	Silver Nanopatch Formation in Ceramic Porous Media for Household-Level Drinking Water Purification: Results of Laboratory and Field Research **J.A. Smith**	**Dr. James Smith**, University of Virginia, **USA**
12:00-12:15	Layer-by-Layer multilayer assemblies of silver nanoparticles with Ni-Crown type Polyoxometalates for the electrocatalytic reduction of chlorate **B. Ali** and T.McCormac	**Ms. Bushra Ali,** Dundalk Institute of Technology, **Ireland**
12:15-12:30	Mechanically-induced top-down synthesizing of nanophases of TiO2 and ZnO photocatalysts and their nanocomposite for potential applications in wastewater treatment **L. Al-Hajji**, E. Shaaban, M.S. El-Eskandarany and F. Al-Mutawaa	**Dr. Latifah Alhajji**, Kuwait Institute for Scientific Research, **Kuwait**
12:30-12:45	Recyclable Epoxy for Demanding Utilisation and Lifetime **M. L. Henriksen** and M. Hinge	**Mr. Martin Henriksen**, Aarhus University, **Denmark**
12:30-14:00	**Lunch Break / Posters Session II**	

Session chairs:
Dr. Khaled Saoud, Virginia Commonwealth University in Qatar- Qatar
Prof. Raed Hashaikeh, Masdar Institute-United Arab Emirates

14:00-14:45	ZnO based Heterogeneous Photocatalytic Water Treatment Under different Irradiation Conditions **K. Saoud**	**Dr. Khaled Saoud,** Virginia Commonwealth University in Qatar, Qatar
14:45-15:00	Treatment of Palm Oil Mill Effluent with Recycled Titanium Dioxide Waste as a Coagulant **M.O. Fatehah** and L.Y. Tan	**Dr. Fatehah Mohd Omar**, Sains Malaysia University, **Malaysia**
15:00-15:15	Hierarchical ZSM-5 catalysts for MTO reaction: catalytic performance and deactivation **L. Lakiss**, Q. Zhengxing, J-P. Gilson, F. Ngoye, L. Pinard, K. Thomas, V. Valtchev, A. Vicente and C. Fernandez.	**Dr. Louwanda Lakiss**, Caen University**, France.**

Session II.C: Functional BioMaterials

Session chairs: Dr. Khaled Saoud, Virginia Commonwealth University in Qatar, Qatar Prof. Massimiliano Barletta, University of Rome Tor Vergata, Italy		
15:15-16:00	Nature Inspires Novel Hierarchical Materials with self-adapting and self-healing ability: application in regenerative medicine **A.Tampieri**	**Prof. Anna Tampieri**, ISTEC-CNR, Faenza, **Italy**
16:00-16:30 Coffee Break / Posters Session II		
16:30-17:00	Amperometric Nanobiochemical Sensing and Signalling of Disease Biomarkers **E. Iwuoha**, N. Ross, X. Fuku, A. Jijana and S. Douman	**Prof. Emmanuel Iwuoha**, University of Western Cape, **South Africa**
17:00-17:30	A Non-invasive CAD system for early detection of RILI using 4D-CT images **F.Taher**, A. Soliman and A. ElBaz	**Dr. Fatma Taher**, Khalifa University, **UAE**
17:30-17:45	Biomorphic transformations of wood into large biomimetic hydroxyapatite scaffolds for limb regeneration **S. Sprio**, A. Ruffini, A. Ballardini, M. Montesi, S. Panseri and A. Tampieri	**Dr. Simone Sprio,** Institute of Science and Technology for Ceramics, ISTEC-CNR, **Italy**

December 7, 2016
Session III: Nanotechnology for Life science and Medecine

Al-Safa 1&2 Conference Room

Session chairs: Prof. Taleb Ibrahim, American University of Sharjah, UAE		
09:00-09:45	Smart Biomimetic nanoparticles: a new platform for nanomedicine **A.Tampieri**	**Prof. Anna Tampieri,** ISTEC-CNR, Faenza, **Italy**
09:45-10:30	Hierarchical Micro/Nano-Porous Acupuncture Needles Offering Enhanced Therapeutic Properties **S-I. In**	**Prof. Suil In**, Department of Energy Systems Engineering (DGIST), **Rep of Korea**
10:30-11:00 Coffee Break		
11:00-11:30	New generation of fluorescent markers for application in Medicine as lung cancer marker M.M. Godlewski, J. Kaszewski, A. Szal, A. Slonska, M.A. Domino, Z. Gajewski and **M.Godlewski**	**Prof. Marek Godlewski**, Institute of Physics PAS, **Poland**
11:30-11:45	Intracellular delivery via heat induction of gold nanoneedles **J. E. Perez**, M. Kavaldzhiev, T. Ravasi and J. Kosel	**Mr Jose Perez**, King Abdullah University of Science and Technology, **Saudi Arabia**
11:45-12:00	High-k oxides by Atomic Layer Deposition - applications as anti-microbal layers M. Godlewski, S. Gieraltowska, L. Wachnicki, R. Pietuszka, B.S. Witkowski1, **M.M. Godlewski**, A. Slonska and Z. Gajewski	**Dr. Michal Godlewski**, Institute of Physics PAS, **Poland**
12:00-12:15	Layer-by-Layer Self-Assembled Dynamic Microcapsules (DynaMicCaps) with Polymer and Protein Shell-walls N.F.D. AlDala'een, I.N. Sabri, W.N.K. Wan Mohamad, N. Alias, A.M. Ali and **J. Shaikh Mohammed**	**Dr. Javeed Shaikh Mohammed**, Sultan Zainal Abidin University (UniSZA), **Malaysia**
12:15-12:30	E171: physico-chemical characterisation of food-grade TiO2 **M. Lorenzetti,** A. Drame and S. Novak	**Dr. Martina Lorenzetti**, Jožef Stefan Institute, **Slovenia**
12:30-12:45	Graphene interaction with immune cells. M. Orecchioni, D. Jasim, M. Pescatori, F. Sgarella, D. Bedognetti, K. Kostarelos, A. Bianco and **L.G. Delogu**	**Dr. Lucia Gemma Delogu**, University of Sassari, **Italy**
13:00-14:00 Lunch		

Posters Sessions

December 5, 2016
Session I: Nanomaterials Fabrication, Characterization and Properties

Al-Safa 3&4 Conference Room

N.	Poster Title	Author/Affiliation/Country
1	Size-Controlled Nano-Dots with Tunable Emissive Property Consisted of a 'Single Conjugated Polymer' **J. Kim**, G. Jang and T. Seung Lee	**Mr Jongho Kim**, Chungnam National University, **Republic of Korea**
2	Hybridization of Conjugated Polymer Nanoparticles with Inor-ganic materials for Biological Detection **T. Seung Lee**, G. Jang, J. Kim, C. Kim and H. Namgung	**Prof. Taek Seung Lee**, Chungnam National University, **Rep. of Korea**
3	Grafting of Boron Cluster Compounds onto different Substrates **M. Benkocká**, S. Lupínková, V. Šícha, M. Londesborough, J. Matoušek and Z. Kolská	**Ms. Monika Benkocká**, J. E. Purkynje University, **Czech Republic**
4	Fluorescent Sensor Probe for Radioactive Isotope Detection using Conjugated Polymer **G. Jang,** J. Kim and T. Seung Lee	**Mr Geunseok Jang**, Chungnam National University, **Rep. of Korea**
5	Investigation of Potential Parameters Effect on Stable Structures of Pt–Pd Alloy Nanoparticles by Particle Swarm Algorithm **G.F. Shao**, M. Zhu, T.D. Liu and Y.H. Wen	**Dr. Guifang Shao**, Xiamen University, **China**
6	Electrical Properties of Hybrid Nanocomposites based on Reduced Graphite Oxide, Multiwall Carbon Nanotubes and Natural Rubber **M. Yazdani-Pedram**, D. Vargas-Astudillo, A. Contreras-Cid and H. Aguilar-Bolados	**Dr. Mehrdad Yazdani-Pedram,** University of Chili, **Chile**.
7	Tunable Open Cavities: A Powerful and Versatile Tool for Ex-ploring Light-Matter Interactions **L. Giriunas**, F. Li, S. Dufferwiel, E. Cancellieri, A. Trichet, P. M. Walker, D. M. Whittaker, J. M. Smith, E. Clarke, I. Farrer, D.A. Ritchie, M. S. Skolnick and D. N. Krizhanovskii	**Mr. Laurynas Giriunas**, University of Sheffield, **UK**
8	Intracellular Thermometry by Using Flourescent Carbon Dots **S. Kalytchuk**, K. Poláková, Y. Wang, J.P. Froning, K. Cepe, A.L. Rogach and R. Zbořil	**Dr. Sergii Kalytchuk**, Palacký University Olomouc, **Czech Republic**
9	Recent Advancement of Electromechanical propereties of metal oxide composites for supercapacitor **M. Huseein** and M. Al Ahmad	**Ms. Minas Huseein**, United Arab Emirates University , AlAin, **UAE**
10	Kinetics of the Acetins Production from Glycerol Esterification with Amberlyst-35 as Catalyst **K.V. Caballero**, V.G. Baldovino-Medrano and G.E. Ramírez-Caballero	**Ms. Karen Vannessa Caballero**, De Santander Industrial Universiy, **Colombia**
11	High performance P-type transparent conducting oxide film by RF magnetron sputtering **Z. Nengduo** and G. Hao	**Mr. Nengduo Zhang**, National University of Singapore, **Singapore**
12	Structural Transformation of Titania Induced by High Energy Ball Milling L. Al-Hajji, **A. Al-Hazza**, E. Shaban, F. Al-Mutawa and M. El-Eskandarany	**Dr. Abdulsalam Alhazza,** Kuwait Institute for Scientific Research, **Kuwait**
13	Preparation, Characterization and Catalytic Activity of Rare Earth Metal Oxides Modified Nanogold Supported CeZrO2 Catalysts **A. Faqeeh**, K. Narasimharao,T. Ali and S. Basahel	**Mr. Alaa Faqeeh**, King Abdulaziz University, **Saudi Arabia**
14	Influence of Mechanical Parameters on the Tribological and Thermal Behaviors of Steel-Composite Carbone/Carbone Couple **A. Benfougha**, K. Boubendira, N. Sassane, M. Boulkra, S. Boukhezar, N. Boughdir and N. Hamzaoui	**Mr. Abdeldjalil Benfoughal,** Research Center in Industrial Technologies (CRTI), Algiers- **Algeria**
15	Study of microscopic and thermal properties of iron-based powders obtained by high-energy ball milling of Calamine **A. Balaska**, T. Chouchane, A. Boudiaf, B. Maalem , A. Hamoud and S. Djemili	**Dr. Adel Balaska**, Resaarch Center In industrial technologies CRTI-Algers, **Algeria**
16	Application Finite Element Method for Temperature Distribution In a fil **L. Cherrad**, H. Benjamaa, D.Idiou and K.Gherfi	**Mr. Mohamed Lotfi Cherrad,** Research in Research Center in Industrial Technologies CRTI, Algers, **Algeria.**

December 6, 2016
Session II. A: Nanomaterials for Water treatment and Environment/ NanoElectronics

Al-Safa 3&4 Conference Room

N.	Poster Title	Author/Affiliation/Country
1	Highly sensitive nano-based touch sensor for robotics applications **A. Al Lataifeh** and M. Al Ahmad	**Ms. Areen Allataifeh**, United Arab Emirates University, Al Ain, **UAE**
2	Electronic and Structural Properties of V-doped CdTe semiconductor in ZB Phase **S. Djeroud**	**Prof. Sacia Djeroud,**University 8 Mai 1945 Guelma**, Algeria**
3	High Performance Asymmetric supercapacitor based on MoS2/GF and activated carbon **T.M. Masikhwa**, J.K. Dangbegnon, A. Bello, M.J. Madito, D. Momodu and N.Manyala	**Ms. Tshifhiwa Masikhwa**, University of Pretoria, **South Africa**
4	Novel Nanocomposites for heavy Metal Ions Removal from Water **MM Esmat**, AH Zaki, AA Farghali, IM El-Sherbiny and MH Khedr	**Mr. Mohamed Esmat**, Beni-Suef University, **Egypt**
5	Detection of Defects in the Materials by Using the Heat Equation **S. Boulkroune**, M. Chaour, A. Boudiaf and S. Benchiheub	**Mr. Sofiane Boulkroune,** Research Center in Industrial Technologies (CRTI), **Algeria**

December 6, 2016
Session II. B: Nanotechnology for Life science and Medecine

6	Nanostructured surfaces of solid substrates for bio-applications **T. Knapová**, M. Benkocká, S. Lupínková, V. Šícha and Z. Kolská	**Mrs. Tereza Knapová**, J. E. Purkynje University, **Czech Republic**
7	Extraction of Chilean Alginate and Preparation of Alginate-PCL Fibers Through Electrospinning **A. Neira Carrillo**	**Dr. Andrónico Neira Carrillo**, University of Chile- **Chile**
8	Advanced Plasma Treatment of Single-walled Carbon Nanotube for more Creation of Functional groups to Immobilize Biomoleculars **J.H. Kim** and N.K. Min	**Mr. Joon Hyub Kim**, Department of Control and Instrumentation Engineering, Korea University, **Rep. of Korea**
9	Targeting Leukemic Cells with Iron Nanowires **N. Alsharif**, J. Perez, A. Bandera, S. Gadhoum, J. Merzaban, T. Ravasi and J. Kosel	**Ms. Nouf Alsharif**, king abdullah university of science and technology **Saudi Arabia**
10	Utilising Novel Nanoparticles for DNA Vaccine Delivery **A. Penumarthi**, D. Parashar, R. Shukla, I. Macreadie and P. Smooker	**Mrs. Alekhya Penumarthi**, RMIT University, Melbourne, **Australia**
11	Surface coated chitosan nanoparticles for the modulation of the protein corona **I. Alradwan**, A. Almalik, I.O. Alanazi, W.M. Alghamdi and Ali H. Alhassan	**Dr. Ibrahim Alradwan**, King Abdulaziz City for Science and Technology (KACST), **Saudi Arabia**
12	Garlic nanoemulsions intended for broiler growth performance **T.C. Lebepe**, Lebogang Katata-Seru, Cornelia Lebopa	**Mr. Thabang Calvin Lebepe**, North West University, South Africa

Session I. A :
Nanomaterials Fabrication, Characterization and Properties

Synthesis and Characterization of Alginate-grafted Graphene Oxide

Sijun Liu, Lin Li*

Nanyang Technological University, School of Mechanical & Aerospace Engineering, Singapore

Abstract:
Sodium alginate (SA) is a natural polymer extracted from various species of brown seaweed. In the presence of divalent cations (e.g., Ca^{2+}, Cu^{2+}, Ba^{2+}, Sr^{2+}, Mg^{2+}), an aqueous solution of sodium alginate is able to form a hydrogel. However, mechanical strength of alginate hydrogels or alginate films is low. Graphene oxide (GO) is a single-atomic layered carbon material, and an oxidized form of graphene. GO can be directly used as a filler to enhance mechanical strength of alginate hydrogels or alginate films. But the effect of GO on improvement in mechanical strength for alginate hydrogels or alginate films is limited by the relatively weak interaction between GO (or even amino-functionalized GO) and alginate.[1]
In order to obtain the strongest interaction of GO with alginate, we have successfully grafted GO with alginate chains for the first time. The GO used for grafting was ammonia functionalized graphene oxide (AGO), which was obtained from Sigma–Aldrich, Singapore. The alginate-grafted AGO is named AGO-g-A. A TEM image of AGO-g-A is shown in Figure 1. The XRD spectra for pure alginate (A), amino-functionalized graphene oxide (AGO), and alginate-grafted AGO (AGO-g-A) are compared in Figure 2. Form the XRD results, it is verified that the crystalline properties of AGO have been changed after grafting with alginate.

The alginate-grafted GO is expected to exhibit significant effect on the sol-gel transition, gel network structure, and gel strength of alginate.

Keywords: graphene oxide, alginate, functionalization, hydrogel, sol-gel transition.

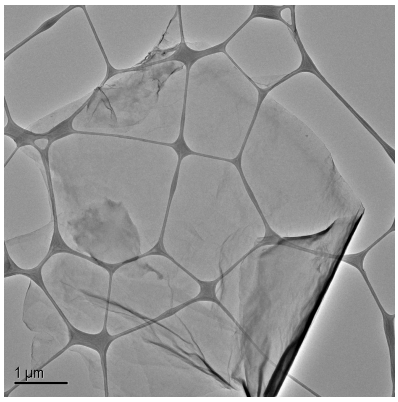

Figure 1: TEM image of alginate- grafted amino-GO (AGO-g-A).

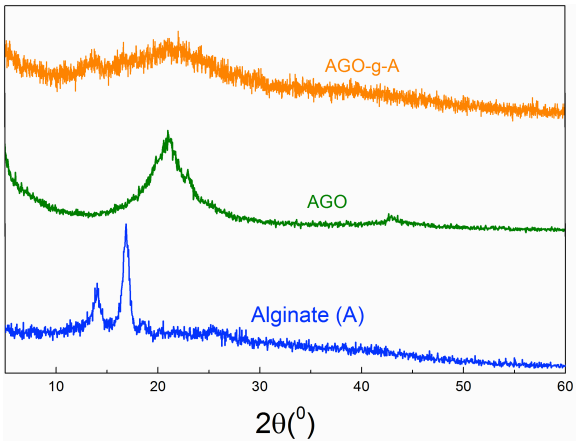

Figure 2: XRD spectra for pure alginate (A), amino-functionalized graphene oxide (AGO), and alginate-grafted AGO (AGO-g-A).

References:

S. Liu, Y. Li, L. Li, Enhanced stability and mechanical strength of sodium alginate composite films, *Carbohydrate Polymers*, under review.

Facile and large-scale Synthesis of High Quality Few-Layered Graphene Nanoplatelets via Methane Decomposition over Unsupported Iron Family Catalysts

A.E. Awadallah,[1,*], A.A. Aboul-Enein,[1], U.F. Kandil,[2], M.R. Taha,[3]

[1] Processes Development Department, Egyptian Petroleum Research Institute, 11727 Cairo, Egypt.
[2] Petroleum Application Department, Egyptian Petroleum Research Institute, 11727 Cairo, Egypt.
[3] Department of Civil Engineering, University of New Mexico, Albuquerque, NM, 87131

Abstract:
High quality few-layered graphene nano-platelets (GNPs) were successfully prepared via catalytic chemical vapor deposition of methane under ambient pressure using substrate-free unsupported iron, cobalt, and nickel metallic sheets as novel catalysts (Figure 1). The bulk catalysts were prepared via combustion method using citric acid as a fuel. Various analytical techniques, including high-resolution transmission electron microscopy (TEM), X-ray diffraction (XRD), thermogravimetric analysis (TGA), temperature programmed reduction (TPR) and Raman spectroscopy were employed to characterize the fresh and reduced catalysts and to identify the morphological structure of the as-grown GNPs. TEM images of the reduced metal catalysts showed that polycrystalline metallic sheets were easily produced after complete reduction of unsupported metal oxides. The data demonstrated that the formation of zero-valent metallic sheets could effectively promote the growth of GNPs on the catalyst surface. The unsupported Ni catalyst exhibits higher catalytic growth activity in terms of GNPs yield (254 wt%) compared with all other catalysts. Raman spectra and TEM results established that a few layers of GNPs with high crystallinity and good graphitization were produced. TGA results further demonstrated that the as-grown GNPs exhibit significantly higher thermal stability in air atmosphere compared with other synthesis methods.

Keywords: Graphene nano-platelets, metallic nano-sheets, methane decomposition, chemical vapor deposition.

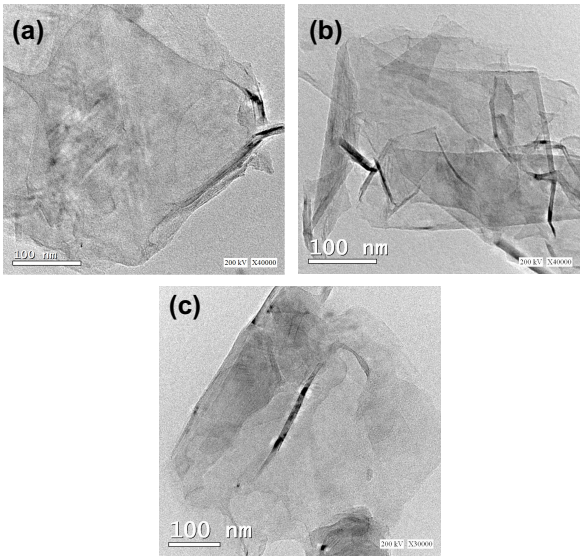

Figure 1: TEM images of as-deposited GNPs over (a) Fe, (b) Co and (c) Ni metallic sheets.

Effect of Film Thickness Variation on the Formation of Metallic Nanoparticles: Titanium Case

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Abstract:
The novel physiochemical properties of metallic nanoparticles (NPs) are mainly governed by the type and structural parameters of the NPs. Hence, controlling the variation in size and shape of NPs leads to a control over their enhancement role in application devices. Moreover, the structure of NPs is highly depending on the processing conditions within the fabrication technique. This paper reports the synthesis of Titanium (Ti) nanoparticles of different sizes by varying the pre-annealed deposited film thickness of Ti. All thin-films produced by e-beam PVD were subjected to thermal annealing at 800 ^{o}C for 30 minutes to form the Ti NPs. Particularly, we investigate the relation between depositing various Ti film thicknesses (2, 4, 6, 8, and 18 nm) with the size, distribution, topography, and optical properties of the formed Ti NPs. UV-Vis measurement and atomic force microscopy (AFM) studies were conducted for un-annealed and annealed Ti thin-films samples. Annealed Ti films have shown clear formation of Ti NPs, visually recognizable in the AFM topography images, with range of roughness values from 0.25 nm to 1.1 nm. On the other hand, un-annealed Ti films showed smoother surfaces with roughness value of 0.05 nm to 0.2 nm with no presence of Ti NPs. Results revealed an increase in the diameter of Ti NPs is related to the increase in the deposited film thickness. In case of thickness 2 nm, average diameter of Ti NPs was 55 nm while the largest average diameter was 145 nm for film thickness 18 nm. Average separation between NPs varied from 17.5 nm to 153 nm for thicknesses 2 nm and 18 nm, respectively. Variation of other parameters such as NPs' heights and coverage were reported for the various thicknesses. For example, in case of thickness 18 nm, almost all NPs have height between 8 and 15 nm. This range of height variation is different for the different thicknesses. Absorption spectra of annealed Ti samples showed a well-structured peak around 308 nm which reflects an enhancement in the absorption compared to as-deposited films which didn't show any absorption peak. This peak is expected to vary for the different thicknesses. Our study provides deep insight on the effect of deposited film thickness by e-beam PVD on the formation of nanoparticles and their optical and structural properties.

Keywords: Ti Nanoparticles, e-beam PVD, AFM, Absorption spectra, Thickness variation.

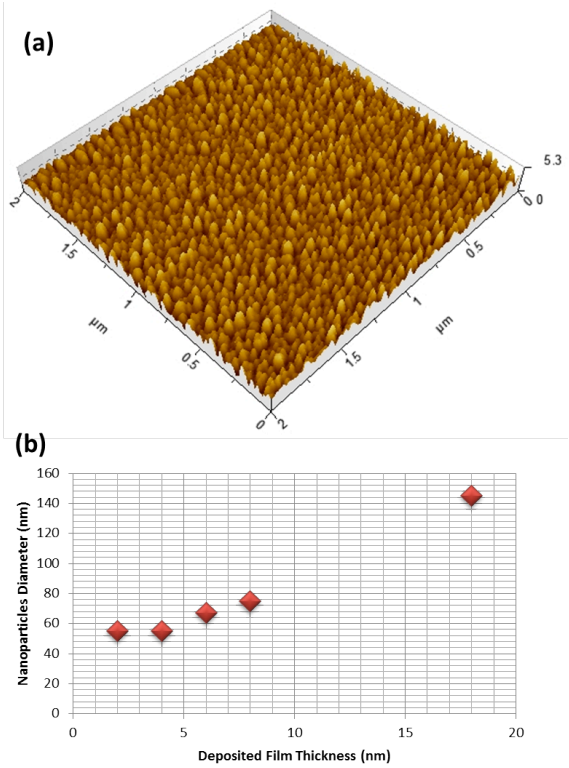

Figure 1: (a) 3D image 2x2 µm topography surface of Ti NPs of Ti films of thickness 18 nm annealed at 800 ^{o}C for 30 minutes. (b) Variation of measured diameter of Ti NPs with deposited film thicknesses.

Metal Oxide Nanomaterials Prepared in Morphology-Directing Agents

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Abstract:
This work describes the synthesis and characterization of some high surface area metal oxide that have environmental applications. Two novel methods will be describes which are:

I) structure directing using water-in-oil microemulsion (e.g., see Figure 1),

II) recovery from polymer composites.

For the first method microemulsion was stabilized by a mixture of the cationic di-n-didodecyldimethyl-mmonium bromide, DDAB, and the nonionic Brij®35 at overall surfactant concentration of 0.1M. For the second method, the metal oxides were prepared by sol-gel processing in a polymer (aramid)-metal oxide hybrid films. The metal oxide content in the hybrid film matrix was one of the studied variables. The calcined samples at various temperatures (in the range 400-1100 oC) were characterized with X-ray diffractometry (XRD), X-ray photoelectron spectroscopy (XPS), electron microscopy, infrared spectroscopy and nitrogen sorptometry. The obtained results will be discussed thoroughly.

Keywords: metal oxide, nanoparticle, sol-gel, microemulsion, surfactant, aramid, polymer composite.

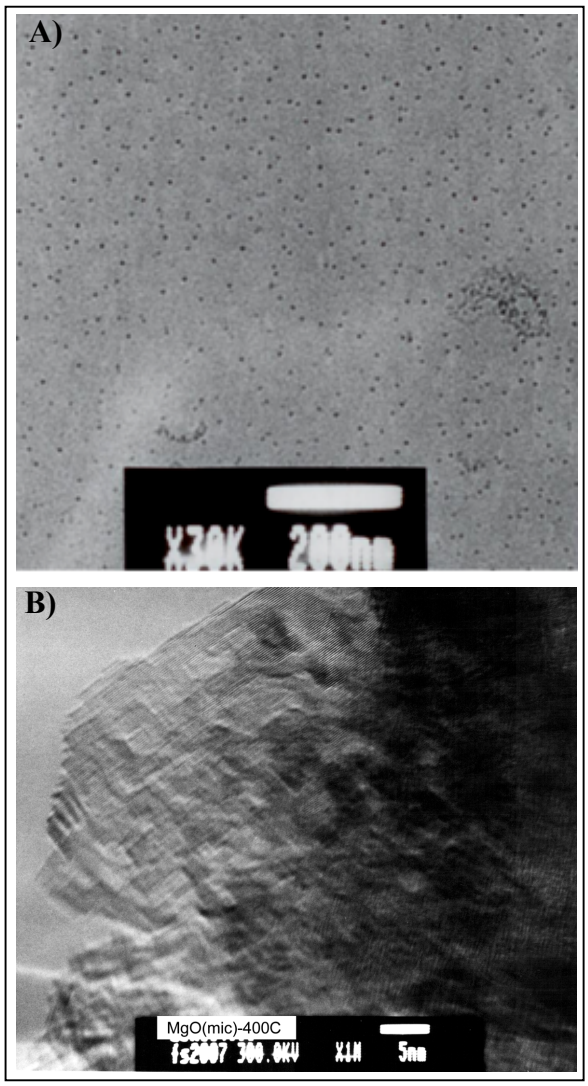

Figure 1: TEM images of some metal oxide nanoparticles prepared in the presence of morphology directing agent. A) well dispersed as-prepared TiO_2, B) MgO nanopowders after calcinations at 400 °C.

Nanostructured Engineered Holographic Diffusers produced by high Throughput Extrusion Patterning

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Abstract:
Modern lighting solutions require sophisticated light management films for creating homogeneous, efficient output with a defined light distribution. The use of LED light sources poses special requirements on the design of these films. At the same time a production process with a well balanced cost-effectivity is required.
One important class of light management films are diffuser films. Especially diffusers with a surface texture achieve high transmission values and thus high optical efficiencies.
In order to achieve a cost-effective production we are using roll-to-roll extrusion patterning[1]. In this process a surface structure is applied to the surface of a polymer film during its production process of the base film providing a minimum of required process steps. Production can be scaled up easily to web widths of 600mm and more with high throughput such as 60m/min.
Mold cylinders are made using a sophisticated method to create tailored diffusers with well designed surface micropatterns. This method is based on a holographic recording method, that can fine tune the composition of the surface frequencies and amplitudes independently in x and y direction (figure 1), allowing the creation of non-isotropic diffusion profiles with pre-defined FWHM values in x and y direction. Transmissivity of the diffuser film can be enhanced (fig. 2) using antireflective nanostructures[2].
We are going to show the potential of the holographic recording method, provide measurements of different holographically originated diffusers, and show the accuracy of the production method by comparing angle-resolved scattering measurements of the produced film with the original master structure. An approach will be presented how to simulate the optical performance of holographic diffuser structure elements and how to integrate them into standard optical simulation systems like ZEMAX optical studio.

Keywords: diffuser film, surface diffusers, holographic diffusers, extrusion patterning, microstructures, polymer film, lighting, efficiency enhancement

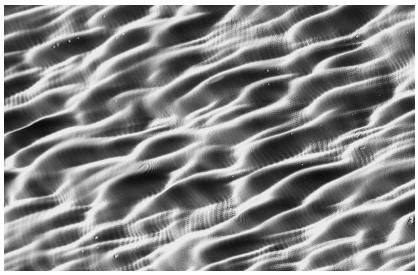

Figure 1: SEM image of a non-isotropic holographic diffuser (original master structure in photoresist)

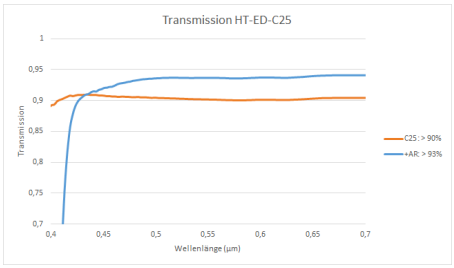

Figure 2: Spectral transmissivity of a holographic diffuser (temicon, type C25, red curve) and combined with an antireflective nanostructure (blue curve)

This work is supported by the European Eurostars program, project no. E!9769

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Electrochemical deposition of alkylphosphonic acid monolayers on Nitinol

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Abstract:
Nitinol (NiTi) is a very attractive material for biomedical applications due to its shape memory and superelasticity properties. However, its high nickel content makes it a potential toxic material because of nickel mutagenicity, carcinogenicity, toxicity and allergenicity[1]. Among the numerous ways explored to tune Nitinol surface properties, improve its corrosion resistance and thus lower its nickel release, the formation of alkylphosphonic acids self-assembled monolayers (SAMs) is a versatile and attractive approach. Recently, electroassisted adsorption of surfactant molecules on active metals has been investigated[2].
We have compared the electroassisted formation (EG) of alkylphosphonic acids (*n*-dodecyl- and *n*-octadecylphosphonic acids) SAMs to passive method (direct adsorption CG) on Nitinol surfaces initially submitted to a one-hour hydrothermal treatment[3]. X-ray photoelectron spectroscopy (XPS), contact angle and polarization curves measurements show that SAMs formed with the electroassisted grafting method are nearly as good as the ones obtained by the conventional immersion method, but in a much shorter time (few minutes vs. several hours). There is no significant impact of grafting time on the layer quality nor on the resulting corrosion resistance of the electroassisted formed SAMs. Grafting potential, on the contrary, appears to influence positively the layers' density and the substrate resistance to corrosion. Alkyl chain length effects on the resulting SAMs properties have also been discussed. Electroassisted grafting is thus confirmed to be a very promising method for the grafting of phosphonic acids derivatives on oxidized metallic surfaces.

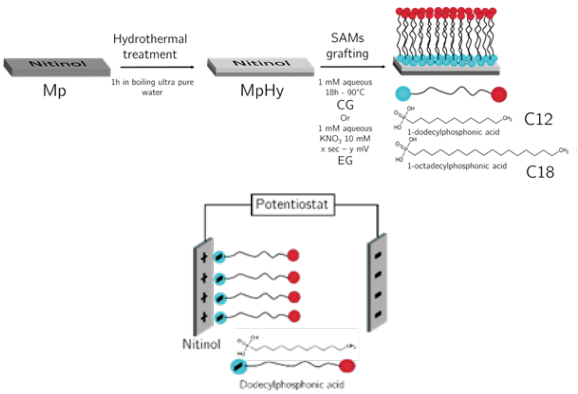

Figure: Schematic illustration of the methodology used for the electrochemical deposition of alkyl phosphonic monolayers on Nitinol.

References:

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A. Vanhooland, S. Devillers, T. Issakova, C. Michaux, J. Delhalle, Z. Mekhalif, Journal of the Electrochemical Society, submitted.

Decoration of multi-wall carbon nanotubes with iron nanoparticles using IR irradiation

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Abstract:
A simple method to decorate multi- wall carbon nanotubes (MWCNTs) with iron nanoparticles using iron (II) acetate as iron source was successfully achieved. Infrared (IR) irradiation has played a very important role in homogeneously decorating MWCNTs with iron nanoparticles. The decoration was achieved in four steps: (1) purification of MWCNTs (average diameter of 10nm), (2) diazonium functionalization on MWCNTs, (3) impregnation of mono carboxylic and tricarboxylic diazonium functionalized MWCNTs by iron (II) acetate using IR irradiation, and (4) calcination under continuous flow of argon gas at appropriate temperature. The decorated nanoparticles on MWCNTs were characterized by different techniques, such as XPS, TEM, PXRD, FE-SEM, TGA and FTIR. It is found that iron nanoparticles are uniformly distributed over MWCNTs. Iron nanoparticles size ranges from 1nm to 5 nm with an average diameter of 3nm. The as obtained iron nanoparticles decorated MWCNTs are expected to have synergistic effects and hence would be of use in many applications such as energy storage and conversion system, electronic devices, chemical and biosensor.

Keywords: multi- wall carbon nanotubes, iron nanoparticles, infrared irradiation, diazonium functionalization, impregnation, argon gas, calcination, homogeneous

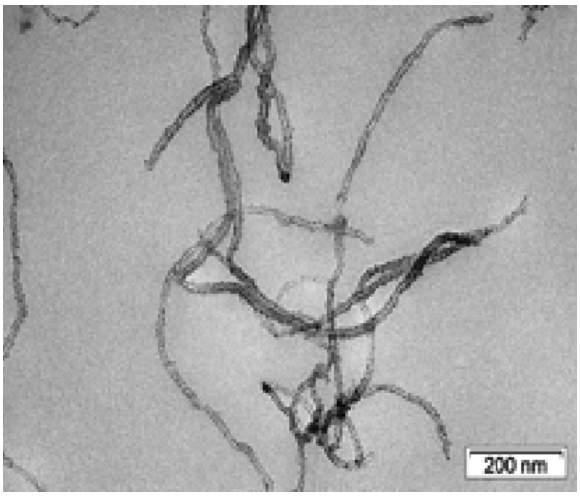

Figure 1: TEM image of iron nanaoparticles deco rated MWCNTs. It is very clear from the image that very small iron nanoparticles are uniformally distributed throught MWCNTs.

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A wafer-Scale Bernal stacked Bilayer Graphene Film Obtained on a Cu(0.61 %at Ni) foil using atmpspheric Pressure vapour Deposition

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Abstract:
Graphene has attracted wide interest due to its promising potential applications in electronics and photonics[1–3]. However, many of these applications are restricted by zero band gap of graphene[4,5]. Nonetheless, a considerable band gap of up to ≠ 250 meV can be opened up in
Bernal (AB) stacked bilayer graphene by applying a perpendicular electric field between the two superimposed layers[5–7]. Hence, graphene synthesis has been focused on growing high-quality and large-area AB-stacked bilayer graphene. Chemical vapour deposition (CVD) is a favourable synthesis technique for graphene since it can grow high-quality and large-area or wafer-scale graphene, which is important for electronic devices[8,9]. In addition, atmospheric-pressure CVD is technologically more accessible for graphene growth. The metallic substrate like Cu which mostly used for CVD grown graphene is found to be favouring to grow monolayer graphene because of limitation of C arbsorption in Cu, while Cu substrate engineered with Ni is found to grow multilayer graphene because of significant arbsorption of C in Ni and hence if it well controlled it can grow AB stacked graphene.
In this study we focuse on the AP-CVD synthesis and characterization of high-quality and wafer-scale (scale of an entire foil) AB-stacked bilayer graphene film obtained on a dilute Cu(0.61 at% Ni) foil and compared the growth to the results of AP-CVD growth under identical conditions on pure Cu foil. Atomic force microscopy (AFM) average step height analysis showed thickness of bilayer graphene, scanning electron microscopy (SEM) micrographs showed uniform and continuous graphene layers and the Raman optical microscopy images and spectroscopy data supported by selected area electron diffraction (SAED) data showed high-quality and continuous (wafer-scale) AB-stacked bilayer graphene for graphene film obtained on a dilute Cu(0.61 at% Ni) foil.

Keywords: Dilute Cu(Ni) foil; Bernal stacked bi-layer graphene; atmospheric pressure CVD

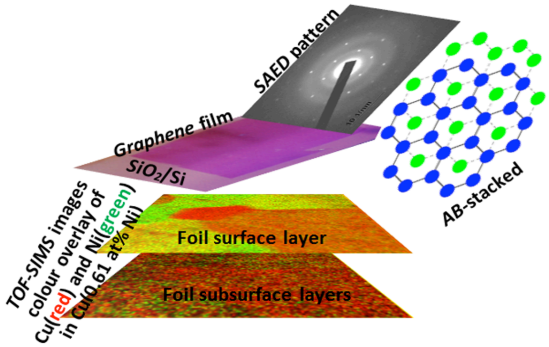

Figure 1: Shows the summarized data of wafer scale AB stacked graphene that was transferred on Si/SiO_2 and analysed by AFM, TEM and ToF SIMS techniques and also showing the schematil of atom arrangements in the AB stacked graphene

References:

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Magnetoresistance and domain wall pinning in multisegmented nanowires

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Abstract:
Existing data storage devices are approaching a standstill in terms of capacity and miniaturization. An alternative approach is the use of planar magnetic nanostripes [1]. Here, bits are represented by nanoscale regions of different magnetization separated by domain walls (DWs). These DWs can be moved using spin polarized currents. The 2D architecture can be advantageously taken into the third dimension by using cylindrical nanowires (NWs), which offer low cost fabrication in densely packed 3D arrays. In addition to this, cylindrical NWs offer potentially faster devices due to the absence of Walker breakdown [2], which would otherwise limit the speed of operation. An important step toward the realization of such a cylindrical NW-based device relies on the demonstration of reliable pinning sites for DWs. We report pinnig of DWs at the interface between hcp Co and fcc Ni segments in multisegmented Co/Ni cylindrical NWs. Moreover, we demonstrate a reliable control of the DW dynamics using magnetotransport measurements.
For this purpose, multisegmented Co/Ni NWs of 80 nm diameter and a total length of 25 μm, with segments of 800nm were fabricated by electrodeposition into anodic aluminium oxide templates [3]. The nanowires were then released and a single NW was isolated. Gold electrodes were further patterned allowing to perform 4-probe measuements of the device magnetoresistance (MR). The voltage was measured and MR obtained as a function of the applied field (i.e. at $\theta = 0$, the field is parallel to the NW). Typical value of resistance at zero field for a NW with 3 segments is 90 Ω. MR measurements of the Co/Ni NWs display several switching steps, indicating the pinning of a DW at Co/Ni interfaces, which propagates only upon further increase of the applied field (Fig. 1). Furthermore, a complete picture of the switching behavior can be obtained by varying the angle of the applied magnetic field. Fig. (1) shows MR curves of the same NW at fields applied parallel (0°) and at 22.5°, 45° and 67.5° to the NW. At larger angles the steps in the switching field become more evident allowing to identify the reversal of individual Ni/Co segments. The MR measurements give an insight into the magnetization switching behaviour of the NW, which is essential for realization of a nanowire-based device.
Thus, the results presented here allow identifying reversal of inidivudal segments and detection of DW pinning sites, providing a way to track the magnetization of the multisegmented NW.

Keywords: nanowire, domain wall, magnetoresistance.

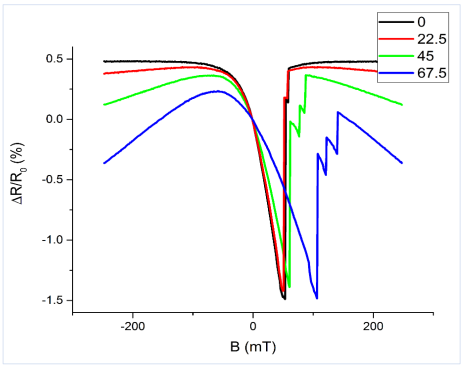

Figure 1: Magnetoresistance curves of a multisegmented Co/Ni NW at different angles of the applied field.

References:

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Synthesis of Silicon-Carbon Films by High-Frequency Deposition

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Abstract:
Silicon-carbon diamond-like thin films are a promising class of amorphous materials. Due to its unique physical properties – high hardness, low coefficient of friction, high chemical resistance and radiation resistance, they find an application in various fields of industry, mainly as protective coatings.
There are many methods of synthesis of diamond-like films. However, currently the development of new technologies is an important task.
This work presents a method of silicon-carbon films production by high-frequency deposition from the vapor mixture. This method is based on the diamond-like films synthesizing technology described by Parkhomenko et al.[1] Here we managed to resolve the main drawback of this technology - the uncontrollable amount of background impurities in the resulting films.
The specimens described in this work were investigated by atomic force microscopy and ESCA. The absence of background impurities in the samples, and the presence of the ratio of sp2 and sp3 links, typical for silicon-carbon films. The method of receiving allows creating doped silicon-carbon films with well-defined physical properties, primarily conductivity, eliminating the influence of background impurities.
The research was financially supported by the Federal Target Program "Investigation and Engineering in HighPriority Lines of Development of Science and Technology in Russia for 2014–2020" (unique project identifier RFMEFI57814X0071, contract no. 14.578.21.0071).

Keywords: Silicon-carbon film, High Frequency Deposition, Protective coating, Diamond-like film.

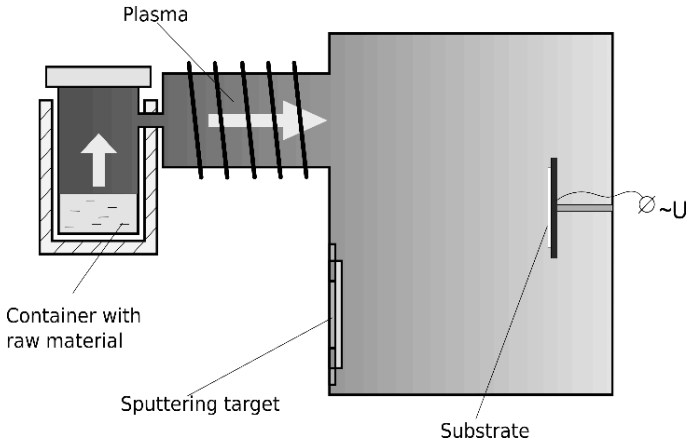

Figure 1: Schematic view of an apparatus for growing doped silicon-carbon films

References:

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TiO_2- graphene gas sensor for the detection of CO_2

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Abstract:
An innovative gas sensor detector topology of potential to detect several gasses simultaneously is proposed, designed and fabricated. The initial detector elaborate materials is to detect CO_2 gas using a thin film TiO_2– graphene as sensitive material. The source of operation is to measure a frequency shift corresponding to certain gas concentration. Therefore the design of this interdigital capacitive based detector has been carried out using the 2.5D sonnet software high frequency simulator. With the carbon dioxide propagation, the TiO_2– graphene based detector both resonance frequency and amplitude will changed according to its concentration. This change is due to the fact that the TiO_2– graphene relative dielectric constant between the metallizations fingers gaps while exposed to carbon dioxide will simply vary its characteristics. In addition to that, in presence of carbon dioxide the conductivity of the fingers changes results in the variation of amplitude. The device has been fabricated and simulated. The measurements are ongoing and will be conducted at room temperature. The choice of TiO_2– graphene is its capabilities to detect combustion gases and toxic gases that could be found particularly in environmental application. Carbon dioxide capturing shows a major role in reducing the concentration of greenhouse gas emissions in the atmosphere and control the effects of global warming which has become an environmental issue of our time of life. In our system we will be developing a well-designed gas sensor using TiO_2- graphene and the fabrication of the sensor. This article highlights how to detect CO_2 gas and reduce it from the atmosphere. Also presents simulation and experimental data to characterize the sensor. The interdigital capacitor is an element for producing a capacitor-like, high pass characteristic using microstrip lines as presented in figure 1.

The TiO_2– graphene film will be placed between the conductors (fingers) for accurate and fully absorption. Figure 2 shows the gas sensor experimental setup block diagram.

Keywords: carbon dioxide, gas sensor, titanium dioxide, fabrication, TiO_2-graphene, metal oxide, interdigital capacitance.

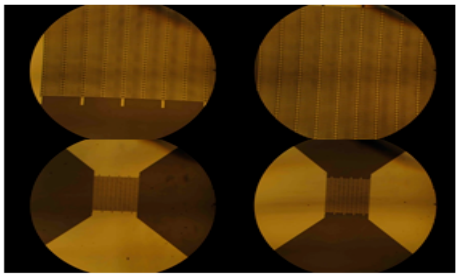

Figure 1: Fabrication of the Interdigital Capacitor (Butterfly patterns)

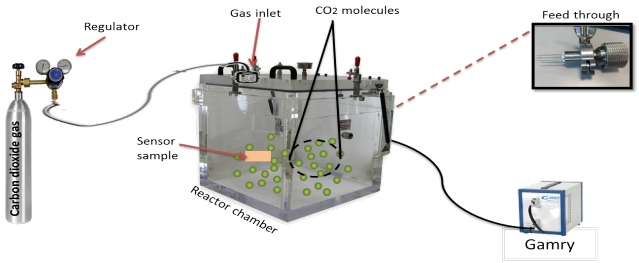

Figure 2: Experimental setup.

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New Information On Water Flow Inside Carbon Nanotubes Reveald by 2D NMR Correlation Spectroscopy

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Abstract:
Understanding confined water, in hydrophobic nano-channels, is important for our understanding of the role of water in biological systems. This has inspired intensive research of water in carbon based materials including carbon nanotubes (CNTs). Nuclear Magnetic Resonance (NMR) is considered an important noninvasive tool for studying water-surface and nano-confined water systems. Standard 1D NMR experiments typically include relaxation, diffusion and line-shape measurements and provide valuable information on the possible existence of multiple relaxation and diffusion modes. Nevertheless they do not provide information on possible correlations among these modes. In general, CNTs form bundles of large number of individual tubes that extends from tens, hundreds to thousands of tubes. Therefore, different possible sites are accessible for water molecules; outer surface of the bundle, interstitial sites between the tubes and internal (endohedral) sites inside the tubes. Water molecules are expected to have multiple motional modes which in turn reflect on their NMR relaxation times and diffusion constants. In this work, two-dimensional Nuclear Magnetic Resonance, 2D-NMR diffusion relaxation (2D D-T_2) was implemented for the first time in order to study the behavior of water confined in inside CNTs. Herein we report the first experimental measurement of fast water diffusion inside CNTs with the help of a 2D 1H NMR method. Unlike previous works where diffusion of water molecules in CNTs was almost solely monitored in the nanoscale with theoretical MD simulations.

Keywords: Water flow, Carbon Nanotube, NMR Correlation Spectroscopy, Water difuseon inside Carbon Nanotubes.

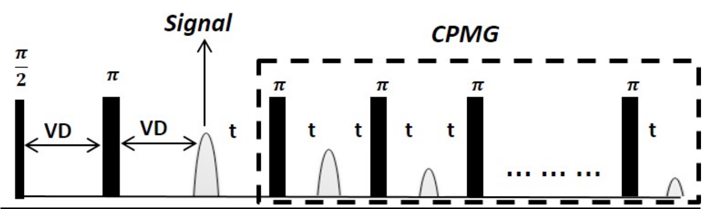

Figure 1: The NMR pulse sequence used in this study. More than 5000 pulses are used.

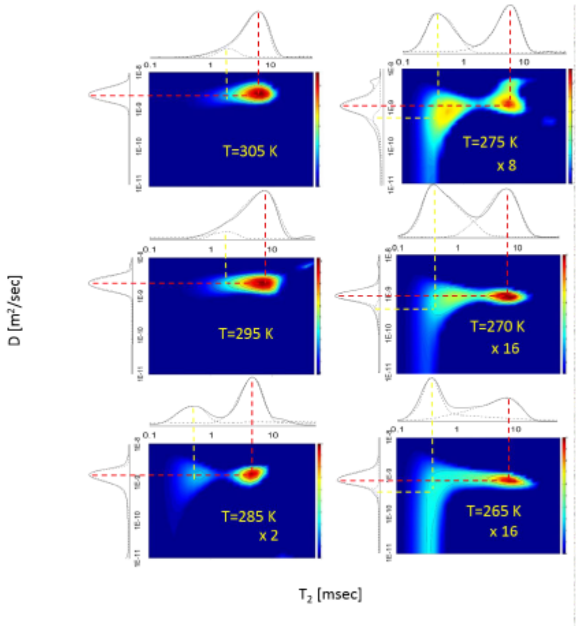

Figure 2: Two Dimensional Diffusion-relxation (2D D-T_2) of water inside Single Walled Carbon Nanotubes at different temperatures.

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Effects of types of reduction and optimization multilayer Graphene Oxide under the influence of Raman Lazer Power

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Abstract:
In this paper, present study two types, reduction of graphite oxide, previously synthesized using the modified method Hummers. First multi-layer graphene oxide (MGO) worked on a substrate of SiO2 / Si, then a heat treatment is made,Then a heat treatment was made, while the second reduced graphite oxide in a furnace, then obtain multilayers reduced graphene oxide (MRGO); both they were reduced to 150 °C. We use Raman spectroscopy to study the optoelectronic properties in these systems, such as defect density, distance between defects, gap and size of the nanocrystals.
Thus, we studied the influence of oxidation and thermal reduction on these parameters in multilayers graphenes. Then using the green laser Raman spectrometer (532 nm) to study the influence of the Raman power on the optoelectronic properties systematically in these systems. These studies allow to evaluate both cases as a comparative system and optimize, come to stability in MRGO.
In addition to these studies, samples were characterized by: Optical Microscopy, Scanning Electron Microscopy (SEM), FTIR spectroscopy and X-ray diffraction.
It is worth mentioning that started from the commercial graphite matrix. Graphite matrices are of the "Empresa Nacional do Grafite" (Minas Gerais Brazil), called commercial graphite.

Keywords: Graphene Oxide, Raman spectroscopy, Optical Properties, Laser Power.

Session I. B :
Advanced Materials Processing

Improvements in mechanical strength and thermal stability of injection and compression molded components in custom-built Poly Lactic Acids (PLAs)

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Abstract:
Bottles and other packaging account for approximately 70% of the global market of biopolymers, which include both biodegradable and durable materials. Durable materials account for the vast majority of the market, especially the bottles. Degradable polymers are instead refrained by the often-insufficient mechanical and thermal properties, which limit their usage to single-use packaging items at ambient temperature and in dry conditions. In this respect, the present work deals with the injection and compression molding process of custom-built Poly Lactic Acids (PLAs), which are designed to be compostable, suitable for food contact and characterized by a good compromise of mechanical properties and thermal stability. A commercial grade PLA was, therefore, compounded in a twin-screw co-rotating extruder by the addition of maleated and glycidyl methacrylate PLAs as chain extenders and micro-lamellar talc as mineral filler and nucleation promoter. After pelletizing, the resulting compounds were melt processed by injection and compression molding, thus producing flat components. Differential Scanning Calorimetry (DSC), Fourier Transform-Infrared Spectroscopy (FTIR), heat deflection and flexural tests in static machine and top-hat cylindrical flat indentations were performed to evaluate the thermal and mechanical response of the molded components. The experimental findings show that crystallization of the PLA can be controlled by fine-tuning the compound formulation as well as by the setting of the processing parameters. In addition, achievement of the appropriate crystallization degree in the polymer are found to lead to molded components, which exhibit improved mechanical strength and high thermal stability. Accordingly, the molded components feature the potential to expand significantly the fields of application of non-durable polymers, thus posing a valid alternative to both durable biopolymers and conventional plastics.

Keywords: Melt processing; Degradable Polymer; Moulding; Mechanical Response; Thermal Stability.

Figure 1: Pellets and moulded item.

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Hydrophilic Polymer Brush Layers on Stainless Steel Using Multi-layered ATRP Initiator Layer

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Abstract:
Polymer coatings on metals e.g. stainless steel are used to modify interfacial properties such as adhesion, friction, wetting, thermal, electrical and optical properties. Industrial coating methods are optimized to produce coatings of large thicknesses (in several tens of micrometer) which rely on properties such as wettability and/or physical adhesion of the coating onto metal substrates. In some industrial applications ultra-thin polymer coatings (several tens of nanometer up to a micron) are needed to increase performance to energy consumption ratio. Nevertheless control over ultra-thin polymer coatings (in tens of nanometer) requires different set of criteria – type of chemical affinity between polymer and the metal and the number of anchoring points – need to be optimized. Surface initiated atom transfer radical polymerization, SI-ATRP, a subgroup of Surface initiated controlled radical polymerization, SI-CRP is a well-known research tool for surface modification. In this *grafting-from* method the monomers are allowed to polymerize from surface immobilized initiator layers.
In this study, we systematically study the influence of the multilayered ATRP initiator layer on the mechanical stability of poly(oligoethylene glycol methacrylate) [poly(OEGMA)] brush layers. Furthermore, a new and simple approach – periodic rejuvenation of surface initiation – is successfully demonstrated to create mechanically stable poly(OEGMA) brush layers of controlled thickness on stainless steel. Finally, we demonstrate that this simple approach can be used to form multi - blocks of polymer brush layers.

Keywords: Polymer coating, polymer brush, SI-ATRP, block-co-polymers, coating characterization, anti-fouling, wettability, super hydrophilic, grafting-from.

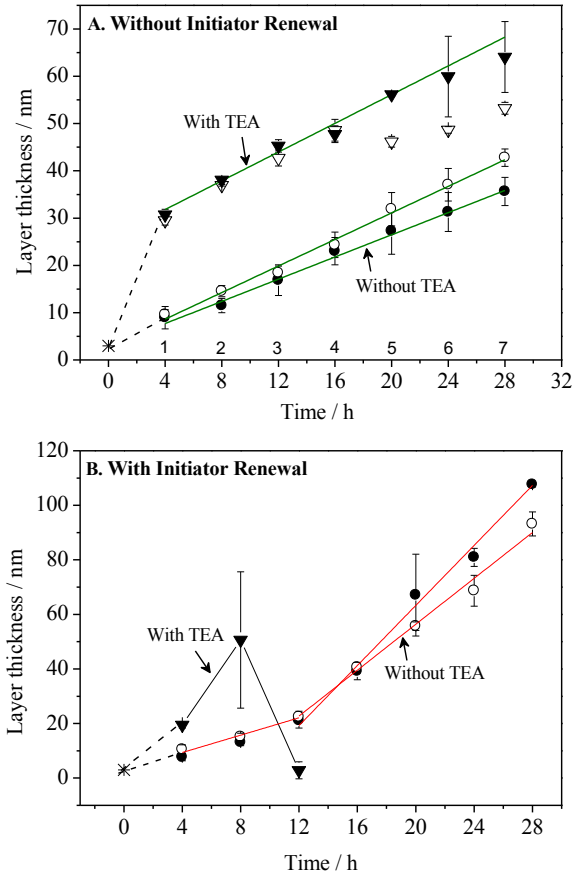

Figure 1 and 2: Thickness of poly(OEGMA) Brush layers on Stainless steel (316L) with and without initiator renewal.

References:

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Temperature- and Time Dependency on High Friction Poly(Styrene-co-Butyl Methacrylate) Coated Paper

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Abstract:
For several industrial applications, high friction surfaces with low adhesion are essential. Here, a poly(styrene-co-butyl methacrylate) polymer latex is coated on paper to achieve a high static friction at the interface between a coating and e.g. a wood pallet. At this interface, the adhesion should be low enough for easy removal of objects placed on the coated paper. The static friction is measured with a custom designed and constructed frictometer (**Figure 1)** with full control over temperature, resting time, sled travel speed, contact pressure, and different load cell ranges. The static friction coefficient is investigated (**Figure 2)** as a function of temperature from 25 to 55 °C and resting time (time the wood is stationary before measuring the static friction). Furthermore, the static friction is investigated with varying coating thicknesses and coatings containing calcium based fillers. Results show that the static friction is increasing non-linearly with both temperature and resting time. Furthermore, an amount of 10 wt% calcium-based filler increases static friction. The static friction increased with temperature until 55 °C, where the integrity of the coating was compromised, as observed by SEM analysis. Wear is not observed at lower temperatures, even at high resting times. In conclusion, the static friction coefficient between coated paper and wood are up to 700 % of uncoated paper depending on temperature and resting time.

Keywords: Static Friction; Adhesion; Polymer; Coating; Coating thickness; SEM; Frictometer; High friction; Resting time; Calcium-based filler; Wear.

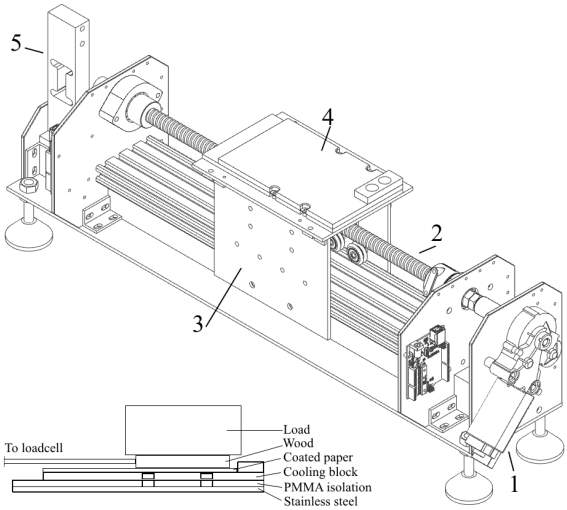

Figure 1: Frictometer. (1) DC Motor; (2) 16mm Ball screw; (3) Movable sled; (4) Cooling block; (5) Load Cell.

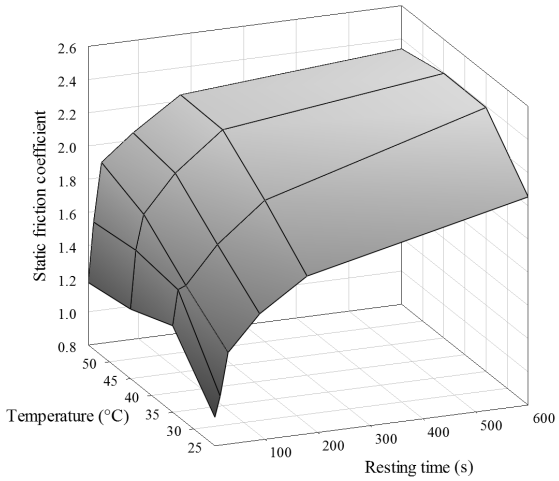

Figure 2: Plot of static friction coefficient from temperature and resting time. The legend displays the static friction coefficient.

References:

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Hybrid joining of Aluminium 7075 T6 with Poly Ethylene Terephthalate (PET) and Poly Ethylene Terephthalate (PET)/Poly Ethylene Vinyl Acetate (PEVA) blends

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Abstract:
Polymers and aluminium are often coupled or joined in hybrid materials that find a multitude of applications in several industrial segments, including packaging, biomedical device and automotive components. In the present work, hybrid joining by high power diode laser of Aluminium 7075 T6 with Poly Ethylene Terephthalate (PET) and Poly Ethylene Terephthalate (PET)/Poly Ethylene Vinyl Acetate (PEVA) blends is proposed. First, PET and PET/PEVA (15 wt. %) foils, 350 μm thick, were extruded by extrusion compounding and starting from commercial grade plastic pellets (Figure 1).

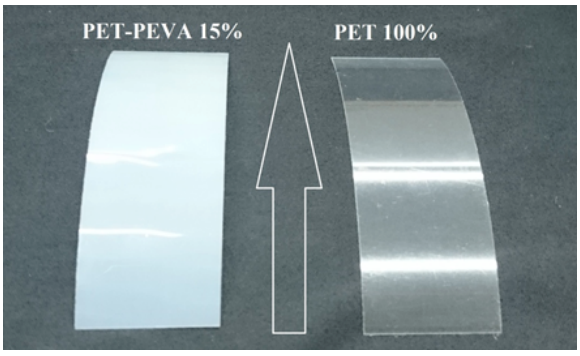

Figure 1: The foils made from PET and PET/PEVA (15 wt. %) blends. Notice the direction of the extrusion process

Then, aluminium 7075 T6 panels with three different kinds of surface treatment were prepared (that is, (i) as-is aluminium; (ii) pre-painted with a black acrylic paint; (iii) anodized). The thickness of the aluminium panels was 1 mm. A joining system in which the polymeric and metal panels were superimposed and clamped through a frame with a Perspex window in the middle was, thus, set. In this way, the laser radiation could pass through the Perspex window, the polymer and, therefore, be absorbed by the faying surface at the polymer-metal interface (Figure 2).

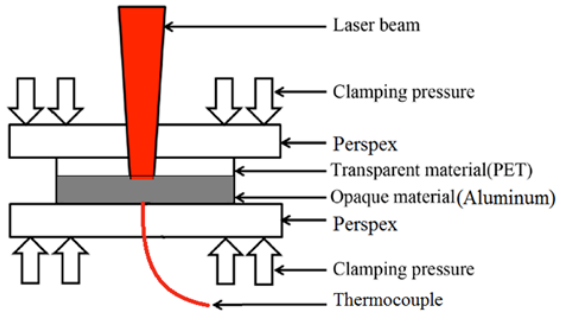

Figure 2: Hybrid joining of polymer and metal: clamping system and set-up of laser irradiation

Laser operational parameters were varied to optimize the joining process. Specifically, laser power was varied from 100 to 250 W, with the scanning speed varying from 3 to 15 mm/s. The mechanical strength of the resulting joints was evaluated by tensile tests. Thermal degradation of the welded joint was evaluated by FT-IR spectroscopy to establish the effect of the laser radiation on the polymeric material.

Figure 3: Typical hybrid joint

Figure 3 shows a typical joint that is achieved during the experimental tests. The hybrid joints are often found to be strong. They also boast good visual appearance on a broad range of laser operational parameters, being affected by minimum, if any, thermal degradation. In conclusion, laser diode is found to be a very promising technology to join dissimilar materials.

Keywords: Metal-Polymer Interface; Hybrid joining; Laser Welding; Welded joints strength.

Session II. A :
Nanomaterials for Energy
Nano electronics

Nanostructures for energy generation and energy conservation

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North Carolina State University, Raleigh, North Carolina, USA

Abstract
The talk will focus on the role of nanostructures and quantum well structures in the fields of energy conservation and energy generation. It will outline the role of light emitting diodes (LED) in optical display devices and solid state lighting for energy conservation. It will also outline the concept of using multiple junctions in achieving high efficiency solar cells for energy generation.
Visible light LEDs based on nanowires in GaN and related compounds have many advantages. GaN nanowires were fabricated by ICP-RIE etching. This was followed by the growth of InGaN/GaN multiple quantum wells on semi-polar facets. The impact of each structure on the internal and the external quantum efficiency will be discussed. Also, multiple quantum well InGaN/GaN in one LED structure with emission in the blue-green and red will be discussed as a source of white light in field LED lighting (solid state lighting). This approach will be compared with other sources of lighting.
In the field of energy generation, the concept of multi-junction solar cells will be outlined to show possible routes for achieving conversion efficiencies near 50%. To achieve the optimum bandgap combination for 3 – 5 junction solar cell structures, tunable band gap junctions are required. The talk will also address the concept of multiple quantum well solar cells to tune the band gap in the ranges of 1.4-1.2 eV and 1.85-1.5 eV. He will also outline methods to achieve record performance tunnel junction need to connect the multiple cells optically and electrically in series.
The talk offers a survey for the current approaches for energy generation and energy conservation with emphasis on recent results achieved in the Bedair's laboratory.

3-dimensional hybrid architecture with graphene and carbon nanotubes for energy storage applications

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** Mechanical Engineering Department, Stevenson Institute of Science and Technology, Hoboken, NJ07030, USA`

Abstract
Electrochemical supercapacitors (SCS) show high energy density and very long cyclibility due to high power density. However, the key challenge for further enhanced capacitance SC lies in fabricating stable structure which can provide large chemically active surface are of materials for SCS. Multi-layeres of graphene consisting of graphene separated by a space material was proposed by researchers in order to fabricate high surface active areas for SCS. However, the graphene layers in such 3D structure may come into contact unavoidably, which may lead to 'aggregation'. We are developing processes for fabricating 3-dimensional (3D) graphene-carbon nanotube (CNT) composite structures to fabricate novel SCS. Graphene-CNT composite 3D structures are novel materials for supercapacitors which posses: (1) large chemically active surface area for large capacitance; (2) high electrical conductivity in all directions; (3) enabling novel thermal management; and (4) realizing enhanced mechanical and chemical stability of devices. Recently, we demonstrated the growth of CNTs on top of graphene layers. The entire process includes: (1) growth of vertical array of CNTs on silicon substrates by a low-pressure chemical vapor deposition (LPCVD) process using anodized aluminum oxide (AAO) nanoporous template fabricated on Si substrates; (2) growth of graphene by another LPCVD process on top of a vertical array of CNTs. The average measured capacitance of the graphene-CNT structure was 850 μFcm^{-2} at $10mVs^{-1}$.

High-Performance Low-Cost Perovskite Semiconductors for Solar Cells and Optoelectronics

Osman M. Bakr

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Abstract:
Three-dimensional lead halide perovskites exhibit impressive long carrier diffusion lengths and low trap densities[1,2], while so-called lower dimensional perovskites such as two-dimensional, zero-dimensional, and perovskite quantum dots, possess large exciton binding energies and high photoluminescence quantum yields [3]. These characteristics make the diverse class of perovskite materials ideal for photodetection, photovoltaics, and light emission. Here we discuss our latest advances in growing and understanding the properties of monocyrstalline perovskites and perovskite nanocrystals, as well as zero-dimensional and two-dimensional perovskites. We demonstrate the integration of these materials in a wide array of optoelectronic applications including: visible-blind UV-photodetectors [4], simultaneously fast and sensitive photodetectors that can operate in both broad-band and narrow-band regimes [5,6], monocrystalline perovskite solar cells [7], efficient light-emitting diodes [8], and color converters for gigabit-rate data transmission with visible light communication systems [9]. Thus, in these device prototypes, we demonstrate the importance of crystallinity, dimensionality, and composition for realizing novel, low-cost and efficient perovskite optoelectronics.

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Flexible Poly(vinylidene fluoride-co-hexafluoropropylene) Nanocomposites filled with Ternary Nanofillers for Energy Harvesting

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Abstract:
Polyvinylidene fluoride (PVDF) is a semi crystalline polymer which has wider acceptance in making nanocomposites for tranducer applications and nanogenerators. Nanocomposites made of PVDF and ceramic nanoparticles like lead zirconium titanate or barium titanate have significant ferroelectric properties compared to pure ceramics. Several diphasic composites of ceramic fillers or other nanoparticle reinforced PVDF are reported in the literature. In this work, we present the synthesis of a novel ternary nanofiller combination (graphene-metal nanotube-ceramic particle) and its influence on the piezoelectric properties of a PVDF copolymer, poly(vinylidene fluoride-co-hexafluoropropylene) or PVDF-HFP. The binary nanomaterial consisting of graphene and titania nanotubes were synthesized following hydrothermal method, and the ceramic nanoparticle, $SrTiO_3$ was added to this combination to develop specific ternary filler combinations. Following the method of solution mixing, the ternary fillers are mixed with PVDF-HFP and composite films of 0.2mm thickness were developed for monitoring the piezoelectric responses. The titania nanotubes grown graphene ensures better distribution of $SrTiO_3$ within the polymer. Contact angle measurements demonstrate higher hydrophobicity for the nanocomposites, establishing the significance of this material in flexible electronics. The energy harvesting is discussed in terms of the piezoelectric constant, d_{33} and obviously the composite containing maximum amount of $SrTiO_3$ gave larger d_{33}. In addition to the applicability of this particular nanocomposite in fabricating nanogenerators, the major challenges existing in the field and specific solutions will also be discussed.
Keywords: piezoelectricity, nanocomposite, graphene-metal nanoadditives, ceramic, dielectric spectroscopy, surface properties, Nanogenerator, ferroelectricity, Filler dispersion.

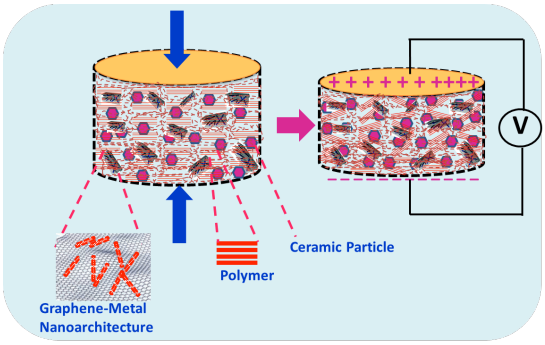

Figure 1: Shematic representation of the structure and mechanism of the PVDF-HFP nanocomposites. The ternary nanofiller combination and the alignment of ceramic particles allow the formation of a hybrid architecture capable of generating electric voltage.

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Rapid and efficient removal of fluoride ions from aqueous solution using a polypyrrole coated hydrous tin oxide nanocomposite

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Abstract:
Polypyrrole/hydrous tin oxide nanocomposites (PPy/HSnO NC 1, 2, 3, 4 and 5) were synthesized through encapsulating HSnO by the PPy via an in situ polymerization for fluoride removal. The optimized adsorbent i.e. PPy/HSnO NC 3 was characterized using FE-SEM, HR-TEM, ATR-FTIR, XRD, BET, TGA and zeta sizer. Microscopic images revealed the encapsulation of HSnO by precipitating PPy during polymerization. The FTIR and XRD studies confirmed the presence of both constituents. The BET surface area and pHpzc of the adsorbent were estimated to be 65.758 m2/g and 7.6, respectively. The fluoride adsorption followed pseudo-second-order model and was commendably rapid. The monolayer capacity was found to be 26.16 - 28.99 mg/g at pH 6.5±0.1. The thermodynamic parameters indicated the sorption of F- was spontaneous, endothermic and that a physisorption occurred. The calculated activation energy (Ea~ 20.05 kJ/mol) provided further evidence of a physisorption mechanism. Moreover, the adsorbent performed very well over a considerably wide pH range of 3.5-8.5 and in the presence of other co-existing ions. The regeneration of the F- laden PPy/HSnO NC 3 showed a high desorption efficiency of 95.81% up to 3 cycles. This study demonstrates the potential utility of the PPy/HSnO NC as an effective adsorbent. Ground water test results also demonstrated the potential utility of th PPy/HSnO NC 3 as an effective adsorbent.

Keywords: Polypyrrole, hydrous tin oxide, adsorption, fluoride, isotherms, rapid kinetics.

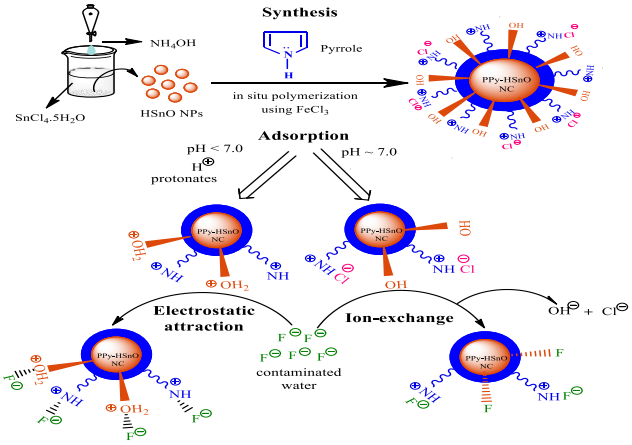

Figure 1: Figure illustrating the fundamental mechanism of synthesis and application of PPy/HSnO NC 3 for water defluoridation.

Magneto-electric Memory in Strain-mediated Multiferroic Nano-heterostructure N*($TbCo_2$/FeCo)-PMN-PT

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Abstract:
The new generation of data storage technology requires high speed, high density, low power and nonvolatile random access memory (RAM). The promising approach for energy efficient RAM is based on magneto-electric (ME) interaction in a nano-composite multiferroic structure [1]. The mechanism of ME interaction in such structures is provided by elastic coupling of magnetic and piezoelectric layers. The energy consumption for sub-nanosecond writing of one bit in a nanoscale strain-mediated magneto-electric memory cell (MELRAM) is estimated on the level of a few attojoules.
Here we demonstrate experimentally not only recording but also reading of stored information using electric field pulses applied to the MELRAM cell.
Fig. 1a. schematically shows the cell that consists of a uniaxial magnetostrictive nano-structure 20*($TbCo_{2\ 5nm}$/ $FeCo_{\ 5nm}$) deposited on a 300 µm thick substrate of ferroelectric relaxor PMN-PT <011>. The cell was placed in a magnetic field H normal to the anisotropy easy axis EA and was included in one branch of a Wheatstone Bridge (WB). The magnetic state of the structure was monitored by magneto-optic Kerr effect (MOKE). Fig.1b shows the electric pulse sequence applied to the structure for demonstration of recording/reading principle. The positive and negative pulses record respectively "1" and "0". Fig.1c shows the electric response across the WB. The positive reading pulse (RP) does not change the state "1" but the negative RP results in switch from "1" to "0". The response contains information recorded both in ferroelectric and magnetic subsystems. Fig.1d shows the MOKE signal corresponding to switch of magnetization by 90° from state "0" to "1" for $H=H_A/\sqrt{2}$, where H_A is magnetic anisotropy field of the memory layer. Fig.1e shows the magnetic component of the electrical response detected as a difference between the signals of Fig.1c for $H=H_A/\sqrt{2}$ and H=0.
Modifications of the schemes for recording/reading functionality of MELRAM are discussed.
The work was supported by grant RFBR 16-29-14022, the StartAirr program MELRAM of the french région Hauts de France, as well as the RENATCH technological network.

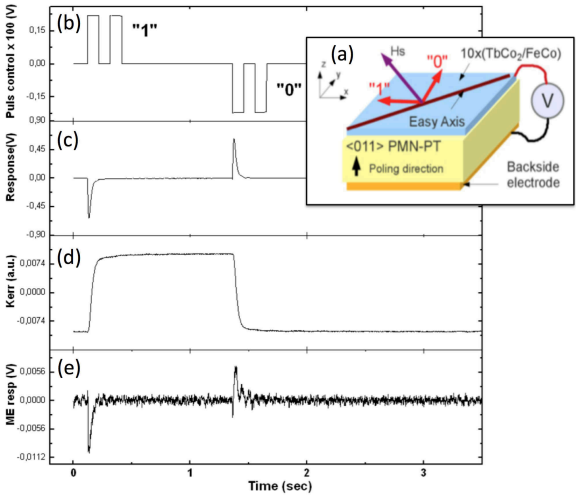

Figure1: (a) ME-memory cell, (b) applied electric pulses, (c) electric response, (d) MOKE measurements, (e) ME-response.

Keywords: Magnetostrictive nanostructure, ferroelectric relaxor, strain-mediated multi-ferroic, memory, recording, reading.

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Single Nanowire Based Nanoelectromechanical Systems

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Abstract:
Nanoelectromechanical systems (NEMS), such as switches, relays and resonators, are next in line of downsizing the existing microelectromechanical systems. Their working principle is based on balancing of electrostatic, adhesion and elastic forces. An example of NEMS is two-terminal nanowire-based switch, where a nanowire is switching between ON and OFF states. The key issue in NEMS operation is "stiction" of the nanowire to the electrode, which occurs due to domination of attractive adhesion forces in the nanowire-electrode contact over repulsive elastic and electrostatic forces. For reliable operation of the NEMS it is necessary to understand what factors influence the nanowire-electrode contact and find a mechanism how to control them successfully. The experiments with NEMS prototypes were performed *in-situ* inside a scanning electron microscope, using a nanomanipulation system for configuring the NEMS elements. Ge and Bi_2Se_3 nanowires were employed as active elements of the NEM systems. Figure 1 demonstrates a two-terminal nanowire-based NEM switch controlled by combined AC-DC electrostatic field, which significantly reduces the required switching voltages. A successful approach how to overcome unwanted "stiction" of the switch elements is using excitation of mechanical resonance in the nanowire. Monitoring the resonant frequency of the nanowire allows to follow changes in the nanowire-electrode contact during the NEM switch operation. Another examples of NEMS demonstrated in this presentation is a nanowire-nased NEM mass sensor for selection, weighting and transfer of individual graphene flakes, and NEM switching in layered ITO/Bi2Se2/ITO devices for thermoelectric applications.

Keywords: Nanoelectromechanical systems, nanowire, switch, contact, mass sensor

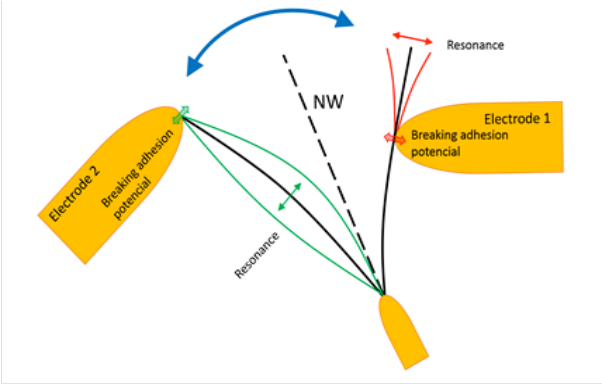

Figure 1: Schematics of AC-DC controlled two-terminal nanowire-based NEM switch configuration.

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Hybrid Plasmonic-Photonic nanolaser

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Abstract:
Lasers first experimentally demonstrated by Schawlow and Townes are among the most important inventions in the 20th century. The ability to generate intense and coherent optical energy has stimulated ground breaking research activities in micro- and nanoscale materials in the past decades. Deeper investigation of the micro- and nano-world requires extremely small, ultrafast, and coherent laser sources to concentrate optical energy into regions with subwavelength dimensions. Over the past 10 years, we have witnessed an explosion in the number and diversity of nanophotonics applications. The downscaling of photonic devices that can efficiently concentrate the optical field into a nanometer-size volume holds great promise for many emerging applications that require tight confinement of optical fields, including information and communication technologies, sensors, enhanced solar cells, and lighting. Although recent efforts in optical microcavities have succeeded in confining light to small mode volume, they remain limited by diffraction - a limitation that prevents squeezing light into spaces smaller than half of its wavelength. Metallic nanostructures have recently attracted considerable interest in the framework of plasmonics. Ultrasmall mode volumes and high local field enhancement are achieved by exploiting surface plasmon resonances. The capability of plasmonic systems to control light–matter interaction at the sub-wavelength scale offers remarkable opportunities to generate many novel concepts and applications in nanophotonics. However, practical implementations have been hampered by limited resonance strength (or confinement time) as a result of optical losses induced by metal absorption and radiation to the free space continuum.

We propose and demonstrate a new hybrid photonic-plasmonic nanolaser that combines the light harvesting features of a dielectric photonic crystal cavity with the extraordinary confining properties of an optical nano-antenna. For this purpose, we developed a novel fabrication method based on multi-step electron-beam lithography. We show that it enables the robust and reproducible production of hybrid structures, using a fully top-down approach to accurately position the antenna. Coherent coupling of the photonic and plasmonic modes is highlighted and opens up a broad range of new hybrid nanophotonic devices.

Keywords: nanophotonics, plasmonics, photonic crystal, hybrid, nano-fabrication, nanocharacterization, laser.

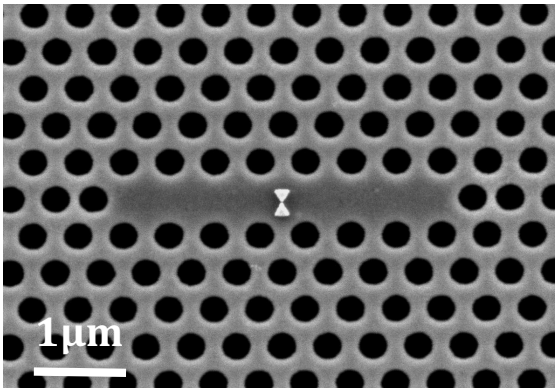

Figure 1: SEM image of the hybrid nanolaser.

MBE Grown InAsSb Nanowire Photodetectors

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Abstract

InAsSb Semiconductor nanowires (NWs) have been considered as promising materials for the fabrication of mid-infrared photodetectors, due to their narrow band gap and the high carrier mobility[1]. In addition when grown on low cost Si substrates they offer the potential for integration with silicon electronics technology and increased functionality. The growth of InAsSb NWs has been reported using different growth techniques, such as Au –catalyzed and more recently by catalyst-free selective area Metal Organic Chemical Vapor Deposition[2]. In this work, we report on the growth of InAsSb NWs on Si substrates using catalyst free-selective area Molecular Beam Epitaxy growth. Highly uniform nanowires were obtained with a strong photoluminescence emission from the wires. X-ray measurments were used to determine the incorporated Sb fraction in the wires, these results were in good agreement with the PL emission, which also confirmed the quality of the grown wires. Growing uniform wires by using free catalyst growth can be used as an effective method compared to metal catalyst growth, as the gold forms trap states in silicon and can limit the efficiency of the fabricated photodetectors. However, while maintaining high crystal quality, nanowires containing a *p-i-n* junction were grown in a square array of a 200 nm pitch. The structure of the nanowires is formed by a first region of doped InAs followed by a second layer consist of InAsSb (*p*-doped, undoped and finally *n*-doped). The fabrication process of the photodetectors was performed by setting in the wires into SU-8 and then etching back using reactive ion etching to expose the tops of the wires. They were then contacted on top using an optically opaque Ti/Au, while Al was deposited on the back of the substrate, forming the back contact. At room temperature the measured dark current density was below 2mA/cm^2 at -0.1 V. Interestingly, the measured dark current for the fabricated photodetector is significantly below the best results reported for large area InAs photodiodes, which typically exhibit ~100mA/cm^2. This is unexpected since InAsSb has a smaller band gap than InAs and the wires have a very large surface area, both factors which would typically increase the current density compared with conventional devices. In addition to this reduction in leakage current density, when also considering enhanced absorption effects in nanowires, there is the potential for an improvement in the signal to noise ratio of 250 times, over the best reported InAs photodetectors. These results shows a promising route for reducing the dark current in photodetector, and highlight the potential of NWs as the next generation technology with a potential for high performance and low cost optoelectronic devices.

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Bidomain ferroelectric crystals: novel actuators for nanotechnology

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Abstract:
Modern nanotechnology is impossible without precision actuators that can provide predictable and accurate movements, from hundreds of micrometers down to subnanometers. One of the most widely used types of these devices is based on utilizing of converse piezoelectric effect. Piezoelectric actuators provide precision movements in scanning probe microscopes (SPM), laser gyroscopes, and deformable mirrors etc. Perspective devices based on piezoelectric actuators include: graphene-based and composite multiferroic laminates, moveable x-ray mirrors, optical waveguides with exact variable geometrical characteristics, MEMS and radioisotope generators.

Mostly, piezoelectric actuators are made of PZT-ceramics ($PbZr_xTi_{1-x}O_3$). However, such disadvantages of ferroelectric PZT ceramic as creep, non-linear character of deformation vs. applied voltage dependence, narrow range of operating temperatures limit the possibility to create highly precision actuators based on this material. On the other hand, piezoelectric single crystals do not possess these drawbacks, demonstrate high thermal and electrical stability and almost do not degrade but have too low piezoelectric coefficients. One of the ways to overcome this problem is to form bidomain structure in plate of ferroelectric crystal such as lithium niobate ($LiNbO_3$) or lithium tantalate ($LiTaO_3$). The bidomain plates with appropriate quality bend according to bimorph scheme when voltage is applied.

In this study we suggest a new technique to create bidomain $LiNbO_3$ and $LiTaO_3$ crystals. The method is based on annealing of a crystalline plate in non-uniform thermal field near Curie point. Main advantages of this technique are rapidity and the possibility to form bidomain structures equally successful in thick plates as in thin ones. We managed to create single crystalline bidomain actuators of large area (up to 10 cm^2) in plates of 0.5 mm thickness. The actuators demonstrated strongly linear dependence of deformation on applied voltage without hysteresis and creep. Movements up to 1000 μm were reached when the actuator was fastened as a console.

We also made an attempt to use bidomain crystals as piezoelectric positioning system of SPM and some scans were obtained.

The study was supported by the Ministry of Education and Science of the Russian Federation (Federal Targeted Programme for Research and Development in Priority Areas of Development of the Russian Scientific and Technological Complex for 2014-2020) (Project ID RFMEFI57815X0102).

Keywords: Bidomain crystal, Lithium niobate, Lithium tantalate, Scanning probe microscopy.

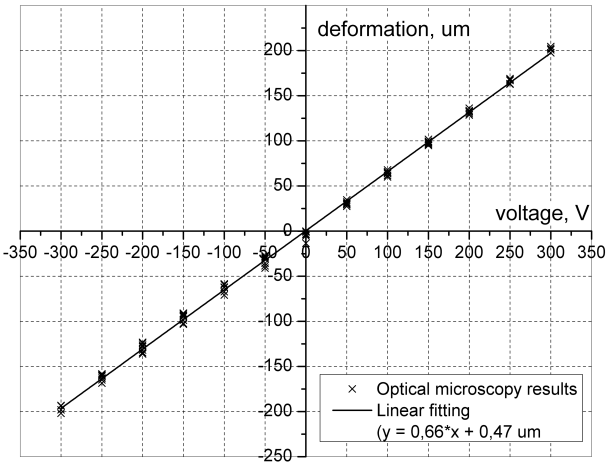

Figure 1: Bimorph's edge movement as a function of an applied voltage for the bidomain plate with thickness of 0.5 mm and the length of 70 mm.

Multivalent electrolyte based V_2O_5/Activated carbon hybrid supercapacitors

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Abstract:
Although Li-ion batteries are known for high energy density, but their limited power density has driven the research toward developing hybrid supercapacitors, which are functionally similar to that of Li-ion batteries [1]. Hybrid Supercapacitors are a combination of electric double layer supercapacitor (EDLC) and pseudocapcitors in which one electrode will store energy by double layer technique whereas the other stores through redox intercalation reactions, respectively, and they exhibit better power density compared to the batteries and more energy density than the EDLCs [2 - 4]. In this study we have investigated the hybrid supercapacitors consisting of Activated Carbon (AC) and Vanadium Pentoxide (V_2O_5) electrode. We have utilized an aqueous multivalent aluminum nitrate (nonahydrate, $Al(NO_3)_3$) electrolyte for increased energy density of the electrodes with more charge of Al^{3+}. A 2M $Al(NO_3)_3$ electrolyte with the best ionicn conductivity was utilized for electrochemical characterization of hybrid supercapacitors through cyclic voltammetry and galvanostatic charge-discharge cycling studies. These studies demonstrated an increased capacitance with decreasing the particle size of V_2O_5 as well as incearsing the electrical conductivity with the addition of carbon nanotubes (CNTs) in the V_2O_5 - CNT composite electrodes. Subsequently, their power and energy densities will be evaluated and compared with the Li-ion batteries and commercial double layer supercapacitors.

Keywords: Hybrid Supercapacitor; Electric double layer supercapacitor; Pseudocapcitors; Activated carbon; Multivalent supercapacitor.

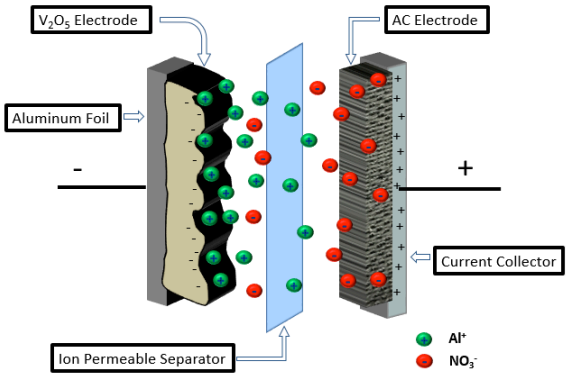

Figure 1: Figure illustrating the functioning of Hybrid supercapacitor using AC and V_2O_5 electrode with $Al(NO_3)_3$ as electrolyte.

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Novel Positive Electrode Materials for Li and Na Ion Rechargeable Batteries

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Abstract:
Developing high-energy and low-cost rechargeable batteries is critically important for future portable electronics, electric vehicles, and the storage of renewable energy. Therefore, Na-ion batteries (SIBs) have attracted much more interest towards replacing the most widely dominating rechargeable Li-ion batteries (LIBs) due to the low cost and large abundance of sodium. Huge research efforts are in continuous progress in order to discover and develop new positive electrode materials in order to achieve good specific capacity, high thermal stability and long cycle life in next generation secondary Li/Na ion batteries. Accordingly, different cathode materials such as $LiCoPO_4$ and $Na_2M_2Fe(PO_4)_3$ [M : Mn, Co, Ni] have been prepared using sol-gel auto-combustion method. Rietveld refinement analyses of powder X-ray diffraction data confirmed the changes in crystal structure and lattice parameters. Moreover, the microstructure and particle size of the as-prepared materials were investigated, using field emission gun scanning electron microscope. The magnetic studies revealed the kind of magnetic structures and magnetization values. Finally, the electrochemical performance of the assembled lithium and sodium batteries was systematically explored and compared in terms of the specific capacity, coulombic efficiency and cycle life.

Keywords:
Poly anionic compounds, autocombustion synthesis, crystallization kinetics, charge-dischage capacity, Neel temperature, electrochemical impedance spectroscopy

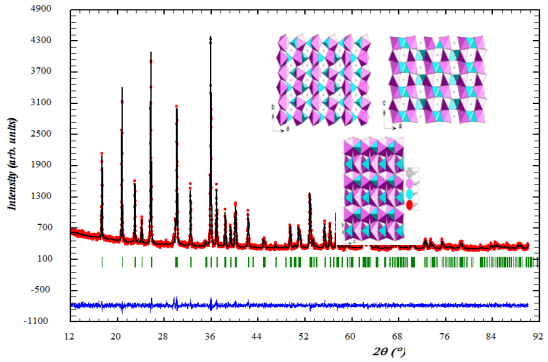

Figure 1: Orthorhombic crystal structure and Rietveld refinement of PXRD pattern of $LiCoPO_4$

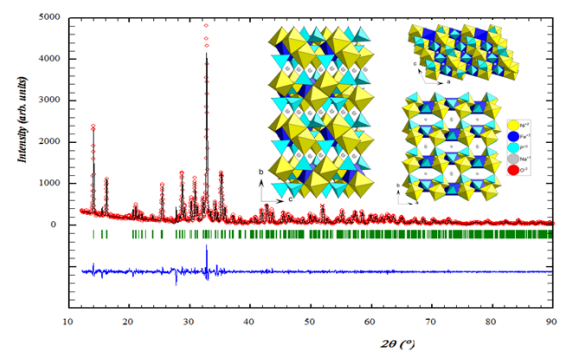

Figure 2: Monoclinic crystal structure and Rietveld refinement of PXRD pattern of $Na_2Mn_2Fe(PO_4)_3$

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Session II. B :
Nanomaterials for Water treatment and Environment

Advanced nanofibers for water treatment and desalination

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Abstract:
Nanofibers are an exciting class of material that has special properties and interesting behaviors that promise to address challenges in water treatment and desalination. Fibrous structures with nanoscale diameters offer a multitude of fascinating features, such as excellent mechanical behavior and large surface area to volume ratio, making them attractive for membrane fabrication. With several possible post-treatments and operating parameter, electrospinning can provide control over the nanofibers microstructure and morphology. As a result, electrospun membranes are increasingly being applied to many water purification applications. The presentation will focus on four classes of nanofibers namely: networked cellulose (NC), nanocrystalline cellulose (NCC), electrospun polymeric nanofibers and carbon nanostructures (CNS). The NC behaviour and properties were utilized to develop reverse osmosis (RO) membranes for desalination [1]. On the other hand, nanocrystalline cellulose (NCC) has very high tensile strength and modulus and was used to reinforce electrospun poly(vinylidenefluoride-co-hexafluoropropylene) (PVDF-HFP) composite mats for application in membrane distillation (MD)[2-3]. CNS are highly entangled carbon nanotubes with improved processability and high electrical conductivity and large surface area. Novel electrically conductive membranes based on CNS material will be presented and their performance for in-situ membrane cleaning will be discussed [4].

Keywords: Electrospun, nanofibers, membrane fabrication, Carbon Nanostructures, electrically conductive membranes, desalination, self cleaning.

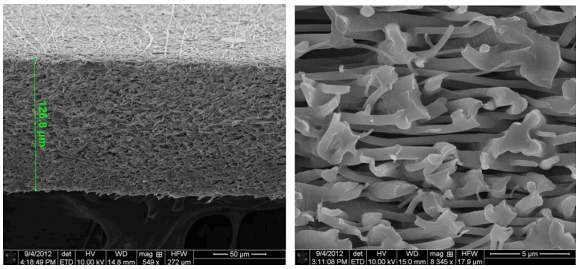

Figure 1: Cross-sectional SEM images of hotpressed poly(vinylidenefluoride-co-hexafluoropropylene) (PVDF-HFP) –layers electrospun membranes [2].

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Applications for Ultraclean Metals Nanofluids Innovative Green Technology & Industrial Unit for Nanofluids Productive Manufacturing

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[3] American-Ukrainian JV "Marketing of Superhard Materials", Leading Researcher, Kiev, Ukraine / Providence, USA
[4] V.Bakul Institute for Superhard Materials NAS Ukraine, Senior Engineer, Kiev, Ukraine

Abstract: Nanofluids are a new class of fluids engineered by dispersing nanometer-sized materials (nanoparticles, nanofibers, nanotubes, etc) in base fluids. Common base fluids consist of water, organic liquids (e.g. ethylene, glycerin, refrigerants, etc.), oils and lubricants. Main attention has been paid in the past decade to this new type of composite fluids because of its enhanced properties and behavior associated with heat transfer, wetting and spreading and antimicrobial activities and the number of publications related to nanofluids rises exponentially.

The presence of metal nanoparticles in fluids can substantially enhance the thermal conductivity depend on the nanoparticle material type and nanoparticles concentration. For example copper nanoparticles are efficient additives to improve the heating and cooling rates of a new phase change material (PCM) for the thermal energy storage of cooling systems [1]. Nanofluids containing silver or titanium nanoparticles could be used as an efficient cooling fluid for devices with high energy density. Metal nanofluids with nanosilver are used as absorbsion media to create a new class of nanofluid-based solar collectors with high efficiency [2]. Extremely wide application area is for antimicrobial nanofluids, containing NanoSilver, NanoCopper, NanoGold which could be used for modification of personal care products, medicine and packing materials [3]

Global Technologies Ltd as a strategic partner of American-Ukrainian JV "Marketing of Superhard Materials" is supporting the introducing to market the new types of concentrated ultraclean Metal Nanofluids manufactured by Innovative One-step Green Technology. The advantages of this technology and Nanofluids are:

- Ultra clean biocompatible Metal Nano Fluid with controllable particles size (25-50 nm for more then 70% of nano particles) and sharp distribution manufactured and encapsulated in liquid media in one step in vacuum;
- Stable highly concentrated dispersions of Metal Nano Particles in water-soluble and water non-soluble custom carrier liquids (100-1000 ppm) suitable for transportation and storage with no special requirements;
- Nontoxic Nano Metal Dispersions for external (internal for Nano Silver) use for human and domestic pets;
- Easy mixing with end products to be modified without changing technology of product manufacturing due to using existing ingredients of end products as carrier liquids: glycerin, natural and artificial oils, polysaccharides, polymers, etc.;
- Productive and cost efficient technology competitive with the best analog world nano products;
- Environmentally clean manufacturing process.

These features are overcoming usual disadvantages of Nanofluids produced by chemical methods as high price, low stability, low productivity, residual chemicals in nanoproducts. The Productive industrial unit for Nanofluid manufacturing (6-20 ton per year) may be built according to custom order [4].

Keywords: Nanofluids, biomedical applications, heat transfer nanofluids.

Silver Nanofluid

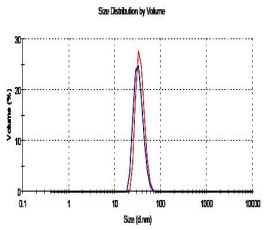


Figure 1: **Silver Nanoparticles size distribution in Glycerin**

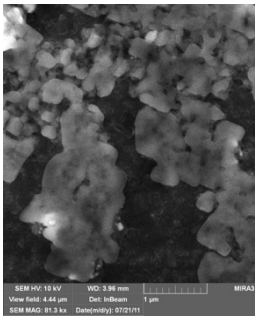


Photo by Elictronic Microscope Mira 3 LMU, Tescan

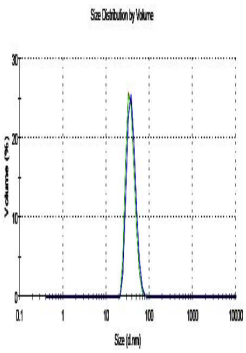
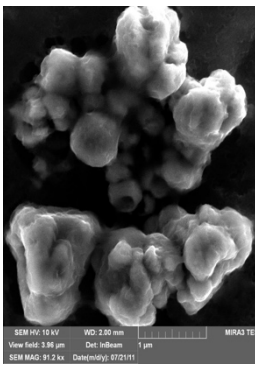


Figure 2: **Gopper Nanofluid**

Particles size distribution in Glycerin



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Application of Graphene, Carbon Nanotubes, and their Magnetite derivatives for the Removal of Heavy Metals and Oil from Produced and Industrial Wastewater

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Abstract:
Oil and gas industries in the Gulf countries and worldwide are consuming huge amount of water during oil and gas fractionation operation, thus generating new stream of wastewater called produced water (PW). Discharge of produced water leads to serious pollution on surface water, ground water and soil. Management of produced water is an immense and essential task in the oil and gas industries to ensure compliance with in-country health, safety rules and regulations and ensure environmental sustainability by decreasing its direct impact on oceans, open lands and /or disposal wells. The physical and chemical characteristics of the generated produced water are drastically different from those of domestic or industrial wastewater. Several technologies are employed for treatment and management of produced water. Conventional technologies for treating produced water can be divided into physical, chemical and biological processes. However, these technologies are uneconomical and invokes major environmental pollution concerns. Hence, it is necessary to introduce novel technologies that can overcome these shortcomings and further enhance the achievement of the production targets, with environmentally friendly and cost effective approach. These new technologies involves the application of different adsorbents for the removal of oil and pollutants from produced water. However, still these new adsorbents are expensive and hard to regenerate for further use. . In this study, and in order to overcome this intricacy, graphene, carbon nanotubes and their modified magnetite derivatives were tested as potential adsorbents for oil removal from produced water. The motivation behind preparing the modified magnetite adsorbents stems from their high magnetic characteristics and as such can respond to external magnetic force which renders their separation from treated water economical and straightforward. Adsorption studies were carried out along with desorption and regenerative to test the efficiencies of these novel adsorbents in oil removal from simulated produced water samples. The results show that these adsorbents exhibit high removal efficiencies (80%-90%) with remarkable, convenient and cost effective regeneration. These results points out that the treated produced water display the minimum current environmental quality standards for the safe discharge without further treatment requirements. The removal of heavy metals from industrial wastewater by these novel adsorbents are currently being investigated.
Keywords: graphene, carbon nanotubes, magnetite, produced water, oil removal, heavy metals removal.

Silver Nanopatch Formation in Ceramic Porous Media for Household-Level Drinking Water Purification: Results of Laboratory and Field Research

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Abstract:
A novel method of fabricating silver "nanopatches" in a tablet-shaped porous ceramic media has been developed and tested for use in household-level water treatment for the developing world. The silver-ceramic media is fabricated using an aluminosilicate clay, water, sawdust, and silver nitrate. The ingredients are mixed in appropriate proportions, pressed into a tablet shape, and fired at 900 ˚C in an electric kiln. During firing, the sawdust combusts, the clay forms a ceramic medium, and the ionic silver is reduced to metallic (zero-valent) silver nanopatches throughout the ceramic pore space. Nanopatch size is normally distributed with mean diameters between 2 and 3 nm (1).

When placed in water, the metallic silver is oxidized to produce ionic silver that diffuses out of the porous tablet into the stored water, providing effective disinfection for water volumes up to 20 L. The silver-ceramic tablet has been designed to produce silver levels effective for pathogen disinfection while still maintaining silver levels well below the drinking water standard of 100 µg/L. Silver released into water is in the ionic form, and the tablet works repeatedly for at least six months, treating 20 L of water per day.

Silver release kinetics are a function of the effective diffusion coefficient of the porous media, sorption of silver ions to ceramic pore walls, and the oxidation rate of metallic silver at the water-nanopatch interface, with the latter process being most important. Overall silver release is most affected by the macroscopic surface area of the tablet; dividing the tablet into smaller pieces increases silver release rates significantly.

In the laboratory, disinfection of *E. coli*, the MS2 phage, *Cryptosporidium parvum*, and *Giardia lamblia* has been quantified. Bacterial log reductions after 8 hours of contact time range from 3-6 log, depending on source water. Viral and protozoa reductions are about 1 log.

The silver ceramic tablet has recently been evaluated in the field in rural areas of Limpopo Province, South Africa and the Dodoma region of Tanzania (2). The tablets were highly effective at reducing coliform bacteria and *E. coli* in residential households and in primary school classroom water supplies with effectiveness lasting up to 1 year. Currently, a human-health study is underway in South Africa with a cohort of 400 households, and early results of this ongoing study will also be reported.

This ceramic tablet embedded with silver nanopatches is a promising new household water treatment technology. The tablet has an anticipated cost of 5 USD and the ability to treat approximately 2000 L of water over a six-month period, making it one of the most affordable technologies for point-of-use water treatment.

Keywords: silver, point-of-use water treatment, disinfection, waterborne pathogens, developing world, household water.

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Layer-by-Layer multilayer assemblies of silver nanoparticles with Ni-Crown type Polyoxometalates for the electrocatalytic reduction of chlorate

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Abstract:
Silver nanoparticles have been synthesized and characterized by Ultraviolet-visible spectroscopy, Atomic force microscopy (AFM) and Transmission electron microscopy (TEM) [1-2]. Multilayer assemblies of the crown-type POM $Ni_4(P_8W_{48}O_{148})$ $(WO_2)]^{28-}$, have been immobilized onto glassy carbon electrode surfaces via the layer-by-layer (LBL) technique employing these synthesized silver nanoparticles (AgNP's) as the cationic layer. Resulting thin films were characterized by different electrochemical and surface techniques. The redox behaviours of both the immobilised POM and the AgNP's are observed. The resulting films were found to be highly conductive through the employment of AC impedance. The resulting films exhibited electrocatalytic properties towards the reduction of chlorate.

Keywords: Transmission electron microscopy, Polyoxometalates, silver nanoparticles, layer-by-layer assembly.

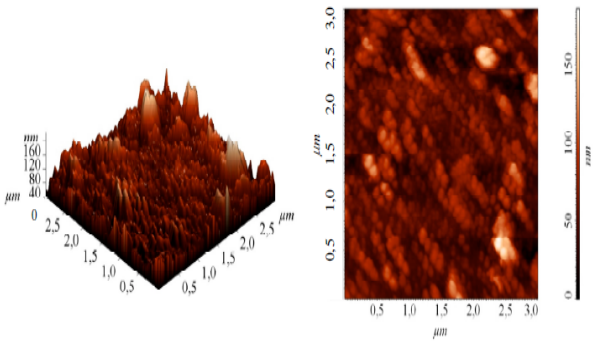

Figure 1: Figure illustrating the AFM imaging of synthesized silver nanoparticles based sensor.

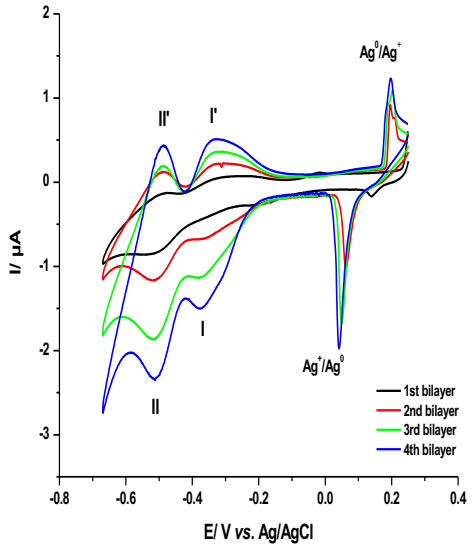

Figure 2: Figure illustrating the silver nanoparticles based sensor for the electrocatalytic reduction of chlorate in water.

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Mechanically-induced top-down synthesizing of nanopahses of TiO_2 and ZnO photocatalysts and their nanocomposite for potential applications in wastewater treatment

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Abstract:
Titanium Oxide and zinc oxide are semiconductors widely used in contaminant degradation processes due to their photocatalytic activity. However, both have limited efficiency due to their wide band gap. Adjusting the band structure to make their photoactivity induced by visible light has been a continuing research stream and has been considered to be the ultimate goal of the photocatalysis process.
Therefore, there has been a dramatic increase in TiO_2/ZnO nanocomposite system. Recently, studies have shown that the use of TiO_2/ZnO composite significantly enhanced the degradation of methyl orange (Liao et al, 2008; Tian et al, 2009). Other Researchers believed that this system had showed higher photocatalytic efficiency in phenol degradation (Liu et al, 2010). However, the photocatalysis of TiO_2/ZnO nanocomposite still demanded the UV irradiation to initiate photodegradation, and yet remaining largely unexplored.
We report the influence of mechanical comminution process on the structure and morphology of TiO_2/ZnO nanocomposite system. the photodegradation of methyl orange (MO) solution was subsequently conducted under UV light irradiation and under direct sun light. to evaluate the photocatalytic efficiency of the nanocomposite in the UV and visible light range, respectively.
Furthermore, we will present the challenges of using photocatalysts in photodegradation of pollutants and the difficulties we are facing in applying nanotechnology in wastewater treatment.

Keywords: band gap, semiconductors, ball milling, photodegradation, wastewater treatment, nanotechnology.

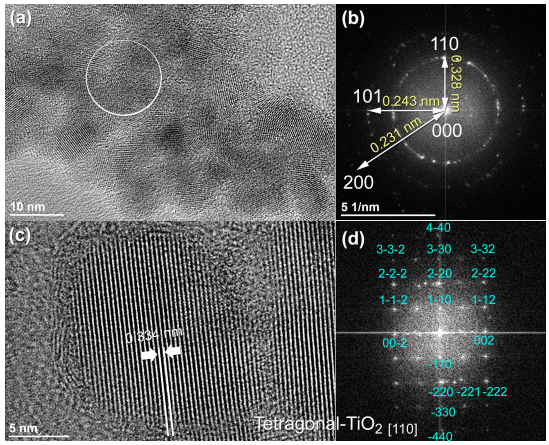

Figure 1: (a) HRTEM image of as-synthesized TiO_2 nanopowders obtained by high-energy ball milling for 9 h. The HRTEM image of a single TiO_2 nanoparticle is shown in (c). The NBDP of (a) and (c) are displayed in (b) and (d), respectively.

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Recyclable Epoxy for demanding utilization and Lifetime

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Abstract:
Glass and carbon fiber enforced epoxy composites find use in many industries e.g. aerospace, maritime, automotive due to its high resistance and good mechanical (strength to weight ratio) properties together with low corrosion compared to metals. The problem with composites arises at "end of life" of the product, since thermosets by definition are irreversible cured, hence it is non-recyclable. The trend towards using materials with a green profile is slowly adapted and explored within composite materials. A benefit for the industry would be reusability of the fibers and epoxy, hereby lowering the costs of existing product manufacturing. Attempts towards recyclability of composite materials have been investigated with subcritical and supercritical conditions [1] together with pyrolysis [2]. Chemical cleavage has been attempted as an alternative approach to make recyclable composite materials, e.g. cleavable disulfide bonds [3] have shown promising results. Our idea is based on a chemical cleaving approach and strives towards usage of environmental friendly materials, additives and processes. It involves the formulation of additives with structures that can be chemically targeted in order to dismantle the matrix when needed. Various attempts towards additives and methods of dismantling were tested employing commercial available epoxy formulations, hence making it directly adaptable for existing industrial manufacturing processes. This work is focused on the choice of additives and its effect on the final cured epoxy. Including how the cured epoxy is performing, mechanically and thermally, are tested and benchmarked to existing demands without any compromises. Further, the dismantling procedure is developed and verified, with respect to temperatures, time and solvents (see figure 1).

Keywords: Thermoset, epoxy, additives, composite materials, recyclability, sustainability.

Figure 1: The virgin epoxy (left) and modified epoxy (right) after 24 hours submerged in the dismantling solvent. The standard epoxy is intact whereas the modified epoxy is completely dismantled.

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ZnO based Heterogeneous Photocatalytic Water Treatment Under different Irradiation Conditions

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Abstract:
Global population is increasing while fresh water supplies are decreasing. It is predicted that by the year 2025 that 48 countries will be short of fresh water. Water purification and desalinization are some of the focus areas meet future water demands globally. Recently, heterogeneous Photocatalysis received much attention in the field of water and air treatment due their excellent photoreaction and antibacterial properties. Most of the studies has been focused on the use of semiconductor photocatalysts for the removal of organic and inorganic species from water.

ZnO show excellent photocatalytic activity to reduce contaminants in the environment. However, due its wide band gap (about 3.2 eV at room temperature) and high excitation binding energy (about 60 meV), it is only allows absorption the UV region of solar spectrum. It has been reported that doping ZnO with noble metals such as Ag or Au enhanced the photocatalytic activity, improve charge separation, and prevent the electro-hole recombination in ZnO due to its electron storage properties[i]. The creation of a local electric field and the optical vibration of surface Plasmon in silver induce enhancement in this electric field and hence enhance the photocatalytic activity[ii].

Here, we report the effect of Silver on the optical, photocatalytic activity and kinetics toward Methalyn Blue (MB) degradation under UV and visible light irradiation, and the antibacterial properties under light and dark illumination conditions. Our results showed that the presence of silver nanoparticles on the surface of ZnO nanorods leads to a significant simultaneous enhancement of the Optical, photocatalytic degradation efficiency of Ag/ZnO photocatalyst towards Methalyn Blue (MB) under UV and visible light irradiation. We found that the increase in photocatalyst dose/concentration is proportional to the photocatalytic efficiency toward degradation of MB under UV and visible light irradiation compared to bare ZnO nanorods. Furthermore, we found that ZnO and Ag/ZnO are both active toward inactivation of Escherichia coli (E. coli) bacteria under visible light. However, ZnO nanorods was deactivated after 72 hours under dark conditions while Ag/ZnO nanocomposits remains active for more than seven months. This results attributed to the presence of Ag nanoparticles on the surface of crystalline ZnO nanorods which extended the lifetime of electrons-holes separation and the presence of silver ion which leads to enhancement in the antibacterial activity towards inactivation of Escherichia coli (E. coli) bacteria under dark conditions. This study provided comparative and experimental evident for the potential applications of Ag/ZnO nanocomposits in many fields such as waste water treatment.

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Treatment of Palm Oil Mill Effluent with Recycled Titanium Dioxide Waste as a Coagulant

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Abstract:
This research focuses on the micro- and nanosize suspended solids in palm oil mill effluent (POME) that is inevitably released in public water courses even after extensive treatment whether it is biological or chemical treatment or advanced treatment. Many of the treatments used for POME released still fails to comply with the standard Malaysian regulations in the Enivonmental Quality Act 1974. The POME suspended particles with a size range below 10 µm are still able to pass through the membrane filtration and enter the environmental aquatic system, subsequently causing a detrimental effect on the surface water quality. It permeates the air and persists in water system in rural areas, fostering an environmental of discomfort and irritation to the society and environment. These toxic particles from the industries is imperative to not only safeguard the aquatic and marine environment but the fishing industry as well as tourism. It is therefore important to anlyze the surface charge and particle size of suspended solids in POME to further understand the dynamics of their behavior and the transformations they undergo in various influential solution conditions. By applying a state of the art technique, this is achieved by measuring the zeta potential and hydrodynamic diameter of the suspended solids and the factors that influence their fate and transprort. By adopting a systematic methodology, the optimum pH can be determined with accuracy and reliable data. This novel technique can later not only facilitiate in treating POME with the appropriate coagulant in suitable conditions but also can be applied on other types of wastewater as well.

Keywords: palm oil fill effluent, POME, ferrous sulphate, pH, COD, color, zeta potential, hydrodynamic diameter, particle size.

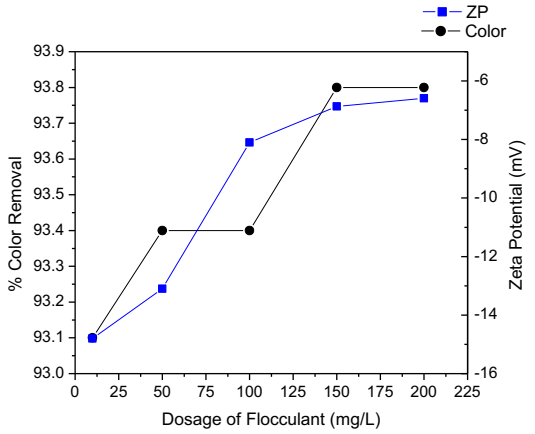

Figure 1 : The effect of different flocculant dosage on color removal and zeta potential of facultative C at raw pH with coagulant dosage of 2,500 mg/L.

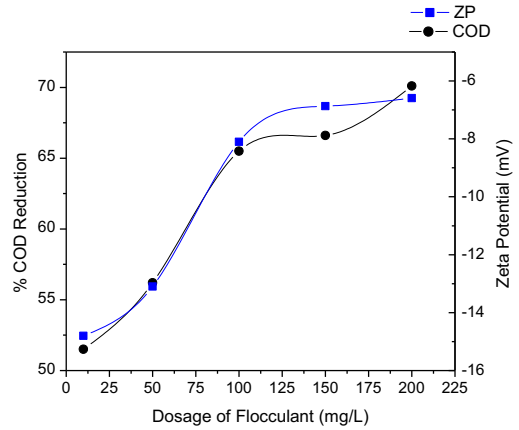

Figure 2 : The effect of different flocculant dosage on COD reduction and zeta potential of facultative C at raw pH with coagulant dosage of 2,500 mg/L.

Hierarchical ZSM-5 catalysts for MTO reaction: catalytic performance and deactivation

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Abstract:
This work highlights the impact of hierarchization on the catalytic activity and deactivation of ZSM-5 catalysts in the conversion of methanol to hydrrocarbons.
Two types of hierarchical ZSM-5 crystals were prepared by two different post-synthetic approaches (alkaline and fluoride leaching), providing materials with micro-macro and micro-meso porosity. (Figure 1) The catalysts are characterized by SEM, ICP, XRD, nitrogen sorption, ^{27}Al and ^{29}Si NMR spectroscopy, and *in-situ* IR spectroscopy.
The catalytic performance of hierarchical zeolites was tested in methanol to hydrocarbons (MTH) reaction and compared with that of parent sample. They show systematically more activity than their parent sample.
The effect of the presence of bimodal porosity on the deactivation of ZSM-5 catalyst over methanol conversion was studied. A new technique (AG-IR) combining thermogravimetrical analysis (TGA) and Fourier transform infrared spectroscopy (FTIR) under operando conditions was employed.
An important advantage of this method is the simultaneously quantification and identification the carbonaceous species formed on the catalyst during the reaction. Thus, a complete study on the factors controlling the coke formation on microporous zeolite-type catalysts was performed.

Acknowledgements. This work was funded by the French National Research Agency (Project ANR 2010 BLAN 723) and the Lower-Normandy Region (Post-doctoral grant of L.K).

Keywords: desilication, fluoride leaching, hierarchization, zeolite, methanol-to hydrocarbons, deactivation.

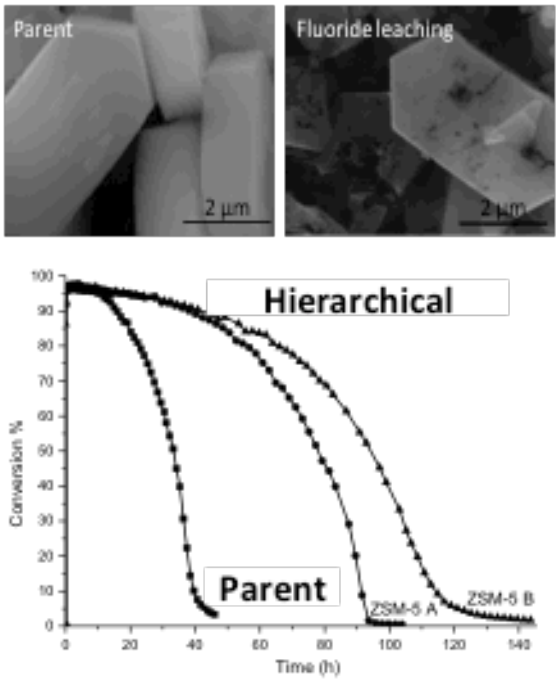

Figure 1: a) SEM micrographs of the parent, fluoride leached ZSM-5zeolite samples, b) Methanol conversion as a function of time on steam at 350°C. (WHSV = 4 g_{MeOH}/ g_{cat} h)

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Session II. C :
Functional BioMaterials

NATURE INSPIRES NOVEL HIERARCHICAL MATERIALS WITH SELF-ADAPTING AND SELF-HEALING ABILITY: APPLICATION IN REGENERATIVE MEDICINE

Anna Tampieri, Simone Sprio, Monica Sandri

Abstract:

Natural structures form and grow upon supramolecular organization and assembly into 3D hierarchical structures, following processes adapting to environmental conditions rather than based on precise and fixed design. Today bio-hybrid and biomorphic materials with outstanding properties can be obtained in laboratory by copying natural processes and structures, thus generating materials for new applications in tissue engineering, heterogeneous catalysis and filtration/purification. Self-adaptation of biomaterials with high mimesis of target tissues can provide excellent healing. In this respect, hybrid collagen/hydroxyapatite scaffolds, due to their excellent mimicry of the newly formed bone tissue, possess the ability to perfectly adapt to the physiological environment by a chemical and morphological perspective, and to be infiltrated by soft newly formed tissues, thus activating the healing process through bridging phenomena.

On the other hand, 3-D bone scaffolds obtained by biomorphic transformation of woods can adapt to the biomechanical stresses thus activating mechanotransduction phenomena and healing in load-bearing bone segments.

Amperometric Nanobiochemical Sensing and Signalling of Disease Biomarkers

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Abstract:
Disease biomarkers are measurable chemical and biological species that can be used to ascertain whether a disease is at its inception, advanced or terminal stage. As biochemical species that are disease indicators, biomarkers have become very important diagnostic tools for disease therapy, particularly for screening and early detection of diseases, including cancers, HIV and tuberculosis. Bioelectrochemical sensors such as enzyme-based sensors, DNA- and DNA aptamer-based genosensors, antibody-based immunosensors and receptor-based receptosens are among the types of diagnostic biosensors that have been developed for the determination of disease biomarkers. The biomarker signalling potential of biosensors can be amplified by the incorporation of nanomaterials such as quantum dots (QDs) (Figure 1), nanoparticles, magnetic nanoparticles, carbon nanotubes, nanopolymers or other nanocomposites. The use of nanomaterials in electrochemical sensing and signalling technologies is mainly due to their very small size, high surface area, favourable electronic properties, specific physicochemical characteristics and excellent biocompatibility. SensorLab has developed several nanobiosensor procedures for the determination of a number of disease biomarkers, including those developed with biocompatible quantum dots[1] and polymeric nanocomposite[2] systems. Among the disease diagnostic sensors are breast cancer genosensor for human epidermal growth factor Her2/Neu oncogene[1]; coeliac disease immunosensor for anti-tissue transglutaminase antibody biomarker for gluten intolerance autoimmune disorder[2]; 17β-estradiol receptorsens devised from estrogen receptor α-recombinant protein (ER-α) bio-sensitizer; and quantum dots genosensors for telomerase reverse transcriptase mRNA cancer biomarker.

Keywords: 17β-estradiol, disease biomarker, electrochemical sensor, genosensors, nanobiosensor, quantum dots, telomerase.

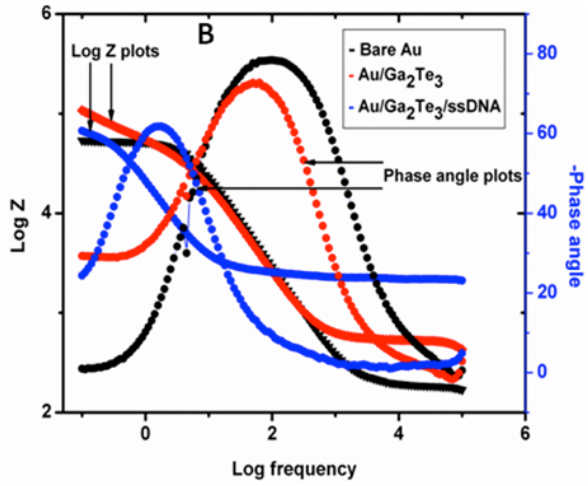

Figure 1: Electrochemical impedance spectroscopy (EIS) Bode plots of bare Au electrode, Au/Ga_2Te_3 quantum dots electrode and Au/Ga_2Te_3/ssDNA genosensor in 0.1 M phosphate buffer, pH = 7.0.

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A Non-invasive CAD system for early detection of RILI using 4D-CT images

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[2] University of Louisiville, Kentucky, USA

Abstract:

The main goal of this project is to develop a non-invasive Computer Assisted Diagnosis (CAD) for early detection of radiation-induced lung injury using 4-Dimensional Computed Tomography images. High-dose radiation has the potential to improve local-regional control and overall survival after fractionated therapy. However, it is challenging to deliver a high dose in the majority of patients as radiation-induced lung injury is an important dose-limiting toxicity during radiotherapy. Clinically significant or symptomatic radiation-related lung injury occurs in 7 to 32 percent of cases, while early, asymptomatic pneumonitis occurs in nearly 50%. Based on the lung cancer incidence within the United States of approximately 220,000 and the percent of patients receiving or expected to receive thoracic radiation as part of their treatment, can be estimated (approximately 132,000). Based on this data, between approximately 50,000 patients will develop symptomatic radiation-induced lung injury, while another 60,000 will develop radiographic pneumonitis per year. Also, in the United Arab Emirates (UAE), Cancer is accounted for 10% of all deaths in 2010, and the incidence of all cancers is projected to double by 2020. Pneumonitis typically occurs 1–3 months after completion of radiation where radiographic findings precede clinical symptoms. The pathogenesis of this condition follows a predictable course, ultimately reaching a point where lung injury resolves or becomes permanent. The overwhelming problem is that intervention often occurs after the disease process is past the reversible stage. Early intervention will likely prevent or reverse the course of this debilitating condition. The proposed study seeks to provide new laboratory-based measures that confer an accurate diagnosis of radiation-induced lung injury based on our novel analysis of 4D CT images to calculate new indices that have the ability to describe both the functionality and appearance. These indices will provide a regional description of any functionality changes stems from the radiotherapy in the very early stages and any appearance regional pneumonitis manifestations. The correlation between regional changes will be studied to provide an early detection stage.

Our preliminary results on 13 independent subjects show the promise of the proposed CAD system as a new non-invasive image-based diagnostic tool. Once successful, it would cause a paradigm change as a new potentially standard benchmark approach for follow-up on the radiotherapy treatment and improvement of local control by dose escalation to regions with less RILI.

These new machine learning tools, developed in this project, will improve the delivery of healthcare in UAE and worldwide by providing a new early diagnostic tool for Lung Injury. Our technology will increase the survival rates after treatment and will reduce the diagnostic costs, benefiting patients, payers, and health insurance organizations.

Keywords: Computer aided diagnosis system, lung injiry, 4-Dimensional Computed Tomography images, radiotherapy.

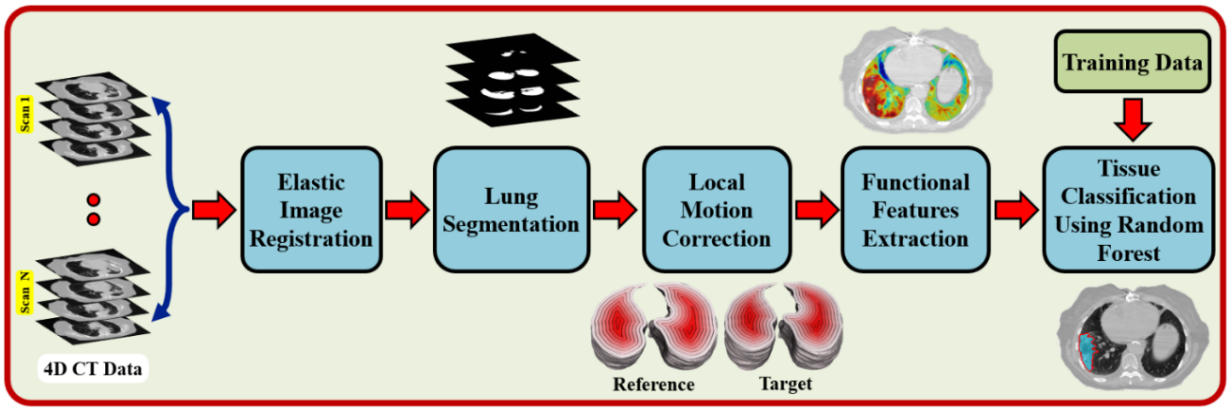

Figure 1: The proposed framework for the detection of lung CT injury.

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Biomorphic transformations of wood into large biomimetic hydroxyapatite scaffolds for limb regeneration

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Abstract:
The treatment of bones affected by comminuted fractures is today among the most challenging surgical procedures in orthopaedics. The use of synthetic, porous hydroxyapatite (HA) scaffolds is considered as the golden solution for bone regeneration. However, intrinsic limitations of the current technologies for ceramic fabrication and the reduced bioactivity of sintered HA hamper the development of large HA scaffolds with effective regenerative ability for load-bearing bone segments. The present work reports on the development and preliminary biologic characterization of new bone scaffolds made of biomimetic, ion-substituted hydroxyapatite (HA). The scaffolds were obtained by nature-inspired synthesis process, namely biomorphic transformation of wood pieces, selected for its outstanding similarity with the Haversian structure of bone (Figure 1). In particular, natural woods were cut into cylindrical pieces and subjected to pyrolysis and a sequence of heterogeneous reactions with gaseous species (O_2, CO_2) thus transforming the wood into calcium carbide, calcium oxide, calcium carbonate and finally hydroxyapatite, by a final treatment in phosphate-rich solution containing also Mg^{2+} and Sr^{2+} ions. The process generated HA nanophase with biologically relevant ionic substitutions, organized in a 3D large scaffold exhibiting porous hierarchical structure reproducing the one of the original wood, and superior mechanical strength. Moreover, in vitro tests in bioreactor reported outstanding overexpression of genes relevant for the bone regenerative cascade that could be attributed to the unique biomimetic features exhibited by the scaffolds. Therefore, new nature-inspired synthesis approach can be considered a revolutionary concept in biomaterials synthesis, thus enabling the achievement of 3D scaffolds with unprecedented features, promising for effective regeneration of load-bearing bones.

Keywords: biomorphic transformation, biomimetic hydroxyapatite, hierarchical structure, bone scaffolds, load-bearing bone

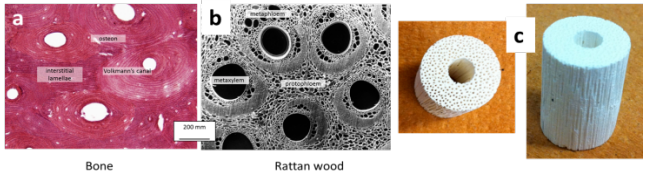

Figure 1: a): Haversian bone structure; b): Rattan wood; c): Biomorphic HA scaffold.

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Session III :
Nanotechnology for Life science and Medecine

SMART BIOMIMETIC NANOPARTICLES: A NEW PLATFORM FOR NANOMEDICINE

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ISTEC-CNR, Faenza Italy

Abstract:
The ever-increasing need of more effective and targeted therapies for the treatment of various degenerative pathologies is pushing material scientists to develop new solutions associating enhanced safety with smart functionality, also permitting the establishment of personalized therapeutic approaches. In this respect, the development and use of nanoparticles is today limited by several factors among which: i) low biodegradability and biocompatibility; ii) toxic by-products; iii) uncontrolled drug release into the bloodstream; iv) limited cell-target specificity and v) low efficiency in crossing biological barriers.
In this respect a novel magnetic apatitic nanoparticle (FeHA) has been recently developed, through controlled substitution of Ca^{2+} ions with $Fe^{2+/3+}$ ions, with specific Fe/Ca and Fe^{2+}/Fe^{3+} ratios. Fe-HA exhibits excellent biocompatibility and biodegradability both in vitro and in vivo, as well as intrinsic superparamagnetic properties that enable remote activation by magnetic signals. Due to its unique features, FeHA can replace SPIONs for a variety of breakthrough applications in regenerative medicine and theranostics. In particular, the new nanoparticles offer a promising opportunity in selective cell targeting and in the translation of magnetic cell-based therapies from laboratory to clinical studies. In fact mesenchymal stem cells can easily endocytose FeHA becoming "magnetic stem cells". After injection, the magnetic labelled cells could be driven by a static magnetic field and localised to the target site where they can perform their specific role.
This approach can also aid tissue engineering approaches forcing the scaffold colonisation overcoming several limitations in critical tissue defects, thus enhancing/shortening the regenerative processes. Besides, such new nanoparticles can link several bio-molecules such as anti-cancer drugs, proteins (e.g. anabolic factors), nucleic acids (i.e. miRNA, siRNA, DNA fragments), and drive them to targeted tissues and released on demand by applying weak magnetic fields.
Moreover, we recently proved the capability of FeHA to work as contrast agent in imaging applications giving to us the great chance to offer a smart tool in medicine. It will be possible, at the same time, live monitoring the injected cells and/or biomolecules, guiding them only to the target site and tuning on demand their release and bioactivity opening brilliant perspective in personalised medicine applications.

Hierarchical Micro/Nano-Porous Acupuncture Needles Offering Enhanced Therapeutic Properties

SU-IL IN

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Abstract:
Acupuncture has long been accepted as an effective therapy for the treatment of many functional disorders, such as pain and psychiatric disorders including anxiety and drug abuse. The invention of acupuncture as a therapeutic treatment is traced as far back as 6000 B.C., originating with the insertion of sharpened stones at specific acupuncture points. The ancient use of sharp stones as an acupuncture device is replaced by that of fine nee-dles made from various materials including bamboo, ceramic, bone, and plant thorns, with these in turn replaced by metal acupuncture needles, including those of gold, silver, copper, and stainless stee. The biological basis of acupuncture still remains unclear, however a considerable number of studies has established a general concept that acupuncture contributes to the neurochemical balance in the central nervous system (CNS) and recovery or maintenance of homeostasis via interactions between needles and the surrounding tissues. In our previous study we reported the activation of the A-beta afferent fiber (sensory nerve fiber) of the ulnar nerve promoting cellular activation by acupuncture at Shenmen (HT7) points for modulating cocaine-induced addictive behavior. Moreover, it is found that mechanoreceptors in the superficial and deep afferents of the ulnar nerve play a functional role in producing acupuncture effects during mechanical stimulation of HT7. Involvement of the afferent fibers in acupuncture is supported by studies investigating acupuncture-like stimulation of superficial or deep tissues for reducing micturition contraction of the urinary bladder and acupuncture analgesia abolished by blockade of afferents fibers from muscle. In acupuncture therapies manual manipulation of acupuncture needles is still the most practicable clinical procedure to enhance the stimulation intensity for improved therapeutic effects. Various needle parameters such as diameter depth of insertion number of needles used per session and needle surface modification have been investigated for improved acupuncture performance. These studies suggest that employing.

Keywords: Electrochemical anodization, Porous acupuncture needles, Neuronal activity, Needle stimulation.

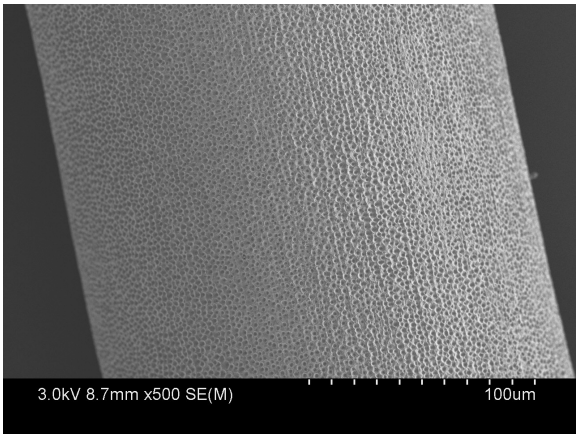

Figure 1: Surface images of the porous anodized needle

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New generation of fluorescent markers for application in Medicine as lung cancer marker

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Abstract:
We have developed a new generation of fluorescent markers (FMs) for application in biology and medicine. FMs are based on wide band gap oxides doped with rare earth ions [1]. First, bioneutrality of developed markers (ZnO and ZrO_2) was proven [1]. The markers feature efficient photoluminescence in a visible light spectral region, show a good stability, the absence of flickering and photobleaching. The possibility of X-ray stimulated fluorescence was demonstrated for selected markers, which allows, following functionalization of markers surface with porphyrin, extension of their used for not only detection, but also for photodynamic therapy of tumors.
An innovative method of introducing those markers to living organisms, via ingestion (intra-gastric gavage (IG)), was demonstrated [1]. FMs were quickly absorbed by the duodenal epithelium and rapidly (within 24 h) distributed through the organism. The specific mechanism of their absorption through the intestinal mucosa into the blood-stream and later from the blood into the tissues and organs remains under investigation. Accumulations of the FMs observed within the enterocytes 3 and 24 h after IG suggested presence of a specific transport system associated with persorption of the nanoparticles from the gut lumen, and their intracellular transport.
Pattern of accumulation of FMs in the organism showed that majority of the blood-organ barriers within organism were permeable for FMs. The only exeption being the blood-lung barrier.

Important information came from observation that FMs can penetrate and gradually accumulate in tumours, including the difficult to diagnose and treet metasthases to the lungs. Our observations (Fig. 1) showed effective trafficking of FMs to the areas of cancer growth (center and right panel) whereas surrounding tissue was impermeable for nanoparticles (left panel).
This shows a high potential of studied FMs in direct tracing of the extent of cancer spread and mathastases in lungs.

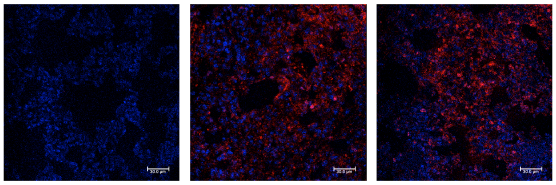

Figure 1: Confocal microscope images of lungs tissues – middle and right image show emission of FMs (red color) from area attacked by cancer. Left image was taken for healthy organism.

The research was partially supported by the National Centre for Research grants "Maestro" 2012/06/A/ST7/00398 and "Sonata-Bis" UMO 2012/05/E/NZ4/02994.

Keywords: Nanoparticles, oxides, rare earth ions, fluorescence labels, cancer

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Intracellular delivery via heat induction of gold nanoneedles

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Abstract:
The efficient intracellular delivery of biologically active molecules is of uttermost importance in any therapeutic application, such as RNAs in gene expression modulation. Physical approaches to disrupt the cell membrane using nanotechnology have been developed to address challenges in intracellular delivery, such as cell toxicity and inefficient transfection. Here, we show a gold nanoneedle-based system to deliver molecules intracellularly by remotely heating the needles. Gold nanoneedles were fabricated using an amorphous silicon membrane, which was made by chemical vapor deposition on top of a silicon substrate with a gold contacting layer. The membrane was patterned with electro beam lithography followed by deep reactive-ion etching. The gold needles were electroplated inside the membrane and then etched, leaving vertical aligned needles on the substrate. Biocompatibility of the nanoneedles was assessed using the combined calcein AM and ethidium homodimer-1 dyes and the HCT 116 colorectal carcinoma cell line as a model (Figure 1). Using an inductive heater, the tips of the nanoneedles were heated, causing localized cell membrane heating in order to gain intracellular access. The results show an excellent biocompatibility of the nanoneedels, with a high intracellular delivery efficiency. The flexible fabrication process provides tunability in the design of the nanoneedles, which when coupled with their biocompatibility and delivery efficiency make for a robust system with potential use in therapeutics.

Keywords: gold nanomaterials, nanoneedles, biocompatibility, electroplating, intracellular delivery, therapeutics

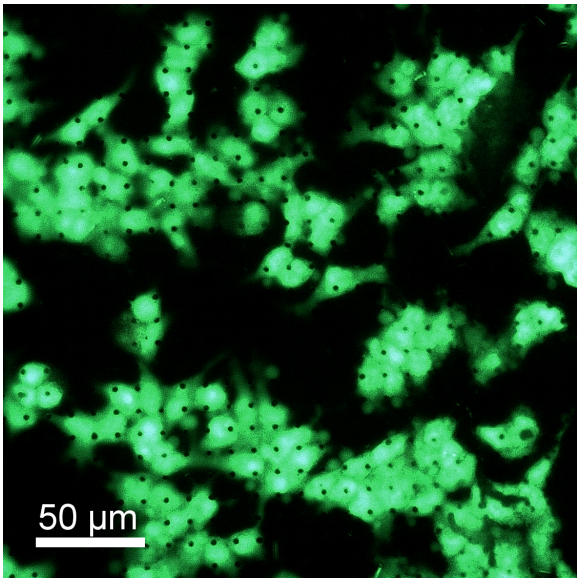

Figure 1: Figure illustrating the biocompatibility of HCT 116 cells growing on the gold nanoneedles. Viable cells take up the calcein AM dye and convert it to the fluorescent green dye calcein.

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High-k oxides by Atomic Layer Deposition - applications as anti-microbal layers

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Abstract:
Wide band gap oxides (ZnO and dielectric films) grown by Atomic Layer Deposition (ALD) are intensively studied for applications in electronic devices [1,2]. For these applications compositions of dielectric films (laminar structures of HfO_2, TiO_2, ZrO_2 and Al_2O_3) show the best parameters [3].

Our research shows that the same layers (ZnO, Al_2O_3, TiO_2, HfO_2, ZrO_2) show antimicrobal activity. For this experiment we used disk diffusion method, which is normally used to determine drug sensitivity. Paper disks coated with thin oxide layers were tested on Mueller-Hinton agar (BioMórieux) substrates plated with bacterial suspensions in saline (0.5 by McFarland). The relevant data are given in the Table 1, showing the results of tests performed for selected bacteria commonly present in hospitals. The highest efficiency of anti-microbal action (measured as wideness of area in which a bacteria spread was blocked, in mm) was observed (in most of the cases) for ZnO, whereas the lowest for TiO_2, when light excitation was not used.

For anti-microbal applications it is important that the ALD allows coating of temperature sensitive materials (such as e.g. surgical masks, gloves, implants), medical equipment and instruments used in hospitals, dentistry and in a food industry. Thus, coating with high-k oxides, showing anti-bacterial activity, can an efficient enhancer in sanitization of coated surfaces, with a range of potential applications in medicine, veterinary, health care and food industry.

Keywords: Atomic Layer Deposition, coating, anti-microbal, wide band gap oxides

	ZnO	ZrO_2	HfO_2	Al_2O_3	TiO_2
Proteus	**2,25±0,29**	2,00±0,58	2,00±0,41	1,63±0,48	0,88±0,25
Salmonella DO	**1,67±1,33**	1,33±1,03	0,75±0,88	0,08±0,20	0,08±0,20
Streptococcus beta-hemolitic	2,63±0,95	2,25±0,50	**3,25±0,50**	1,75±1,26	1,88±1,75
Staphylococcus aureus nr 2	**2,63±0,48**	2,50±0,41	2,38±0,25	1,50±0,41	0,88±0,25
Staphylococcus epidermidis	**4,00±1,87**	3,75±1,19	**4,00±1,22**	2,63±0,75	2,50±1,78
Staphylococcus pseudintermedius	**6,63±0,48**	5,88±0,25	5,88±0,63	6,13±0,85	4,88±0,63
Staphylococcus aureus nr 1	1,88±0,63	**2,38±0,48**	2,25±0,50	0,88±0,48	0,00
Bacillus subtilis	4,38±0,25	**5,38±0,48**	5,13±0,25	4,25±0,50	0,00

Table 1: Efficiency of anti-microbal action of selected wide band gap oxides.

The research was partially supported by the National Centre for Research grant "Maestro" (2012/06/A/ST7/00398).

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Layer-by-Layer Self-Assembled Dynamic Microcapsules (DynaMicCaps) with Polymer and Protein Shell-walls

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Abstract:
Triggered delivery is one of the key areas of ongoing research in the field of drug delivery. To achieve triggered drug delivery, a variety of stimuli have been used including light, heat, ultrasound, magnetic field, pH, chemical species, etc. The Murphy group Bioinspired Materials Lab (BML) at UW-Madison has demonstrated biochemical ligand triggered drug delivery from PEG-CaM-PEG (PEG- Poly(ethylene glycol), CaM-Calmodulin) hydrogel slabs and microspheres based on the nanoscale conformational changes of hinge motion protein calmodulin (King, Mohammed, & Murphy, 2009; King, Pytel, Ng, & Murphy, 2010). To our knowledge, there has been no report of triggered drug delivery from dynamic microcapsules. This work presents fabrication (refer to Figure 1) and preliminary results of layer-by-layer (LbL) self-assembled dynamic microcapsules (DynaMicCaps) whose multilayered shell-walls are comprised of polyelectrolytes (polymers whose repeating units bear an electrolyte group) and CaM. It is anticipated that the triggered volume changes in the nano-engineered hollow microcarriers, DynaMicCaps, can be used in triggered drug release applications.

Keywords: layer-by-layer (LbL) self-assembly, multilayer nanofilms, microcapsules, calmodulin (CaM), hinge motion proteins, protein conformational changes, triggered drug delivery.

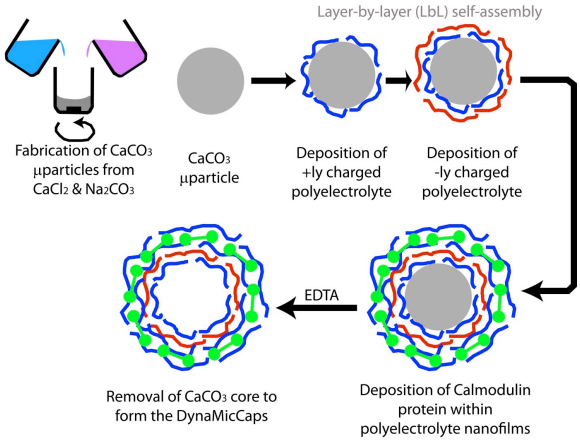

Figure 1: Illustration showing the different steps in the fabrication of DynaMicCaps: Calcium carbonate ($CaCO_3$) microparticles (μparticles) made by mixing of $CaCl_2$ and Na_2CO_3 solutions under vigorous stirring, electrostatic LbL self-assembly technique used to deposit multilayer nanofilms of polyelectrolytes and CaM onto $CaCO_3$ μparticles, and $CaCO_3$ cores dissolved using Ethylenediaminetetraacetic acid (EDTA) to form hollow nano-engineered DynaMicCaps.

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E171: physico-chemical characterisation of food-grade TiO_2

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Abstract:
Titanium dioxide (TiO_2) is used as white pigment in food stuff and personal care products, as well as in paints, plastics and paper industry. Its use as food colorant (labelled as E171) is regulated by the European Directive 94/36/EC and authorised as "*quantum satis*", while its amount is limited to 1 % by weight of food according to the US Food and Drug Administration authority. Due to TiO_2 spread use, the daily human exposure is increasingly raising, causing lots of concerns about its safety.

TiO_2-based food colours for cake decoration can be easily purchased from the market, so that they were chosen as case study material. The aim was to characterise different E171-based colours in the form of powder. The performed physico-chemical analyses represent the preliminary step to predict the biological and environmental risks associated with the use of such food grade TiO_2-based colours.

Scanning and Transmission Electron Microscopy, Energy Dispersive X-ray Analysis, Infrared spectroscopy, and X-ray Diffractometry were applied to study the particle morphology, size, as well as the chemical and phase composition of the dry powders. Measurements of zeta potential and Particle Size Distribution in water and in physiological solutions disclosed the surface charge and size of the particles in different pH conditions and in presence of different electrolytes and ions. The effect of protein corona (bovine serum albumin) on the dispersibility of the TiO_2 particles was also studied. The photoactivity of the food-grade E171-based colours was studied by monitoring the organics degradation (10 ppm caffeine solution) upon UV irradiation.

The analyses revealed that the powders were made of titanium dioxide, as well as other coloured inorganic/organic compounds, as declared on the label. All particles were round-shaped, with an average size ≈120 nm and quite spread size distribution, depanding on the used solvent. The majority of the particle formed micron-sized agglomerates, but a fraction up to 30% of single or clustered particles fitted within the nano-range.

The formation of a protein corona around the TiO_2 particles increased the dispersibility of the powder, demonstrated by the drop of the effective diameter. Such a behaviour could facilitate the cellular uptake of TiO_2 within the gastrointestinal tract, and the particle distribution and bioavailability in other body compartment.

The E171-based powders were also able to degrade arganics (caffeine molecules) under UV light activation, even though in different extents in basis of their composition. Their photocatalytic activity was in fact related to their physico-chemical properties. For instance, pure white pigments composed of solely TiO_2 or TiO_2 and SiO_2 mixtures photocatalitically destroyed caffeine completely. On the other hand, caffeine degradation was lower when other organic components where present together with TiO_2 (i.e. "champagne", "petal blue" and "cream" colours).

Based on the obtained results on particle size, dispersibility, and surface charge in physiological solutions, it can be expected that the food grade TiO_2-based colours can interact with the gastrointestinal tract once ingested and can be internalised. In our opinion, such an outcome should warn about the possible toxic effects of these TiO_2-based powders for food preparation, i.e. cake decoration. Accordingly, further studies will be necessary to assess the *in vitro* toxicity and body distribution of the TiO_2-based (nano)particles.

Keywords: titanium dioxide, nanoparticles, food, additives, colours, particle size, zeta potential, protein corona, UV photoactivity.

Graphene interaction with immune cells.

Marco Orecchioni[1], Dhifaf Jasim[2], Mario Pescatori[1], Francesco Sgarella[1], Davide Bedognetti[3], Kostas Kostarelos[2], Alberto Bianco[4] and Lucia Gemma Delogu[1*]

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Abstract:

Graphene based nanomaterials are gaining the attention of the scientific community and the public for their future applications in the biomedical field [1]. In this context, the immune impact of different chemical-physical characteristics of graphene materials are one of the most fundamental areas of interest and is still understudied [2]. We focused on the molecular effects on primary human immune cells of different Graphene Oxides (GOs), deeply characterized for lateral size dimension (GO Small and GO Large) and for functionalization ($GONH_2$ 2) large and ($GONH_2$4) small. The functionalization of $GONH_2$2 and $GONH_2$4 was performed by 1, 3-dipolar cycloaddition of amino groups. To deeply investigate the immune impact of GOs we performed a wide range of standard assays, looking at cell viability and cell activation. We characterized the molecular impact of GOs on 84 genes immune-response correlated. Additionally, a whole genome analysis was conducted on T cells and monocytes as representative of the innate and adaptive immune response. We did not detect any toxicity in GOs treated samples [3]. The 84 gene expression analysis showed 16 upregulated genes in the GO-Large samples compared to only 5 genes for GO-Small, evidencing a clear dimension-dependent impact. The data were further confirmed with cytokine analysis [3]. Genes modulated by GO-Small (red squares) were intrigingly involved in some relevant pathways (**Fig. 1**) [3]. These evidences were confirmed by the whole genome analysis [3]. Microarray data also suggested that the functionalized GOs ($GONH_2$2, $GONH_2$4) were able to significantly reduce the number of genes modulated improving biocompatibility. Moreover the functionalized GOs and specifically small $GONH_2$4 had shown a stronger activation of the immune response if compared with the Large ones (**Fig. 3**). We found also a significant up-regulation of some activation pathways mediated by small GO3 and $GONH_2$4 in T-cells and in monocytes (**Fig. 3**), with a strong induction of genes such as: CXCL family and their receptors: CXCR3, CCR2 (**Fig. 3 red boxes**) commonly activated during immune-mediated tumor rejection and pathogen clearance process, giving future perspectives for nano-anticancer systems. This work represents an immune comprehensive characterization of different-sized and functionalized GOs paving the foundations for future chemical and physical design and screening for preclinical studies.

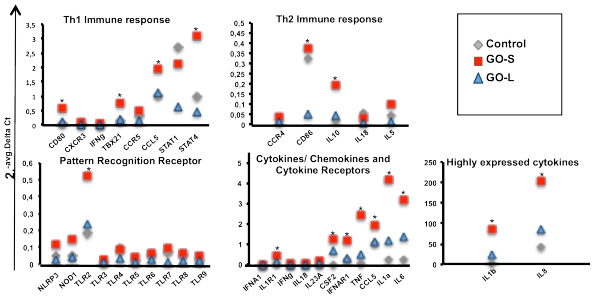

Figure 1 Immune gene expression analysis

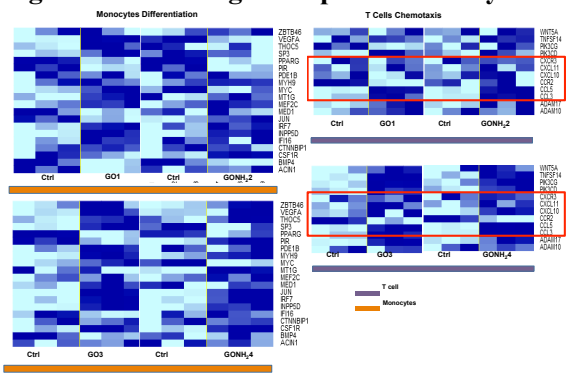

Figure 2. Gene ontology significant modulated pathways (P value <0.005)

Keywords: carbon nanomaterials; graphene; immunotherapy; immunotoxicity; genomic modulation; nanomedicine

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Posters Session I :
Nanomaterials Fabrication, Characterization and Properties

Size-Controlled Nano-Dots with Tunable Emissive Property Consisted of a 'Single Conjugated Polymer'

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Abstract:
The size-dependent tunable electronical, optical and magnetical properties of nanomaterials are essential to the current excitement and developing applications of nanomaterials. Among such nanomaterials, semiconductor quantum dots (QDs) are generally used material for active component in device technology and biomedical technology, though research in biomedical technology using QDs has diminished because of their negative properties, such as toxicity and harmful fabrication process for QDs. Thus, new nanomaterials which have biocompetable and nontoxic properties are needed for replacement of existing size-dependent properties tunable semiconducting materials.
For that reason, we introduced conjugated polymer used for fabrication of size-dependent emitting property tunable nanoparticles. Conjugated polymers (CPs), a kind of remarkable conducting materials, have been widely used for optical devices, due to their large-conjugated backbones which lead to delocalized electronic structure. We fabricated size-dependent tunable fluorescence color of Pdots from single conjugated polymer as like as QDs. We prepared our Pdots with various particle sizes through two different method, reprecipitation and micro-emulsification method. Our CPs are composed of phenylene backbone with benzoselenadiazole as electron accepting moiety. Benzoselenadiazole in CPs is included small amount with regard to phenylene parts, in order to obtain different fluorescence color in solution and solid state. So, control of particle size can induce change in amount of electron transfer from phenylene as electron donor to benzoselenadiazole as electro acceptor. For instance, small sized Pdot emitted blue light excited at 348 nm, which caused by dominant emitting property of phenylene backbone in Pdot, but large sized Pdot emitted yellowish green light which came from long wavelength emissive character of benzoselenadiazole which is getting the energy trasferred from phenylene backbone as energy donor. Finally, we realized size-dependent tunable fluorescence color of Pdots not only by reprecipitation method, but also by micro-emulsification method. And this result of our work suggests that divers color emissive Pdots with various particle sizes in this work will be able to use for diverse research fields, instead of such existing size-dependent properties tunable semiconducting materials.

Keywords: size-dependent tunable property, conjugated polymer, nanoparticles, reprecipitation method, single emitter.

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Hybridization of Conjugated Polymer Nanoparticles with Inorganic materials for Biological Detection

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Abstract:
Conjugated polymers have drawn a great deal of interest because of their peculiar thermal stability, conducting properties, and emission properties. Thus, the potential properties of conjugated polymers lead to a variety of applications in organic light-emitting diodes, organic thin film transistors, organic photovoltaic cells, chemical sensors, and biosensors. A great deal of attentions has been focused on nano-sized materials including particles, fibers, and tubes for pursuing various applications such as optoelectronic devices, multimodal imaging, and biomedical medicine. Especially, nanoparticles fabricated from conjugated polymers have interesting properties, such as good photostability, high quantum yields, excellent biocompatibility, and low cytotoxicity, which can be utilized for fluorescent probes.[1] Surface modification of such conjugated polymer nanoparticles becomes important in biologically-relevant investigations because the colloidal stability of the nanoparticles in aqueous solution is successfully obtained. FRET occurs between an energy-donor chromophore and a suitable energy-acceptor chromophore. There are requirements for FRET: First, the emission spectrum of the donor chromophore should overlap the absorption spectrum of the acceptor chromophore. Second, these two molecules must be close in proximity (less than 10 nm).[2] The FRET phenomenon simultaneously increases the fluorescence intensity of the energy acceptor and decreases that of the energy donor. Using FRET mechanism, conjugated-polymer-based biosensors are useful for the detection of biomaterials. We are demonstrating new, versatile conjugated polymer nanoparticle-based, hybridized materials for interesting optical properties as well as a specific detection of biomedical target analytes.

Keywords: sensors, fluorescence, FRET, conjugated polymer nanoparticles, protein sensing, biosnesor.

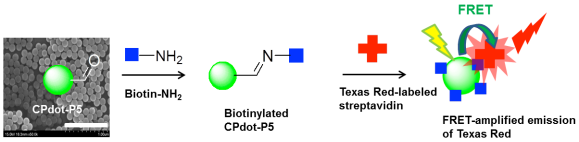

Figure 1: Representative sensing mechnism for streptavidin with biotinylated CPdot-**P5**.

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Grafting of Boron Cluster Compounds onto different Substrates

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Abstract: Natural and synthetic polymers or silicates play crucial role in many areas of our live, industry, medicine, research due to their properties. But their surface properties can limit their further use in some areas. Physical or chemical modification of these surfaces can change their chemical composition and subsequent better adhesion of grafed compounds. We can use this for development of new materials for electronics, biomedicine or for development of a new nanocomposite luminophores. We have modified surfaces of different substrates by chemical methods and we studied the changes of surface properties. The activated surfaces were grafted with selected vicinal compounds and subsequently with different boron cluster compounds. In some cases we obtained materials of high fluorescence under UV-lamp. The surface properties of the modified materials changed significantly and were studied using various methods.

Keywords: polymer foil, silicate, Piranha solution, boron cluster compounds, electrokinetic analysis, X-ray photoelectron spectroscopy, fluorescence.

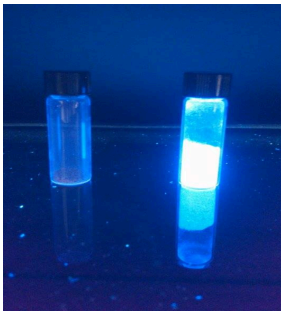

Figure 1: Montmorillonite (MMT) under the UV-lamp; MMT grafted with cysteamine (left), MMT grafted with cysteamine and subsequently with highly fluorescent boron cluster (right).

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Acknowledgement

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Fluorescent Sensor Probe for Radioactive Isotope Detection using Conjugated Polymer

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Abstract:
The major source of cesium involves nuclear waste and cesium is one of the most important radioisotopes with negative health effects, including cardiovascular disease. Recently, a large of quantities of radioactive isotopes were released from Fukushima Nuclear Power Plant damaged by the earthquake and tsunami on 2011. Selective and sensitive detection of cesium is importance and its toxicity is due to its ability to replace potassium in red cells. Current methods for cesium detection include atomic absorption spectroscopy, radioanalysis and inductively coupled plasma mass spectroscopy. These methods are sensitive for cesium detection but they are expensive. Fluorescence-based sensors have rarely been used for cesium detection. So, it is very important that synthesize of probe molecule for detection of radioactive isotopes such as Cs. Recently, fluorescence molecules have received increasing attention as a fluorescence sensor for the radioisotopes. Especially, conjugated polymers (CPs) have received much attention as sensory materials. Many researchers have investigated CP sensor consists of ethylene glycol chain. This chain was well known as a good selectivity for alkali cations. In this reason, we considered the idea of using ethylene glycol moieties to form cesium binding site on the conjugated polymer. This sensor has a good selectivity for cesium. We observed that this sensor exhibited fluorescence color change via complexation with cesium in aqueous solution.

Keywords: Conjugated polymer, fluorescence sensor, cesium detection.

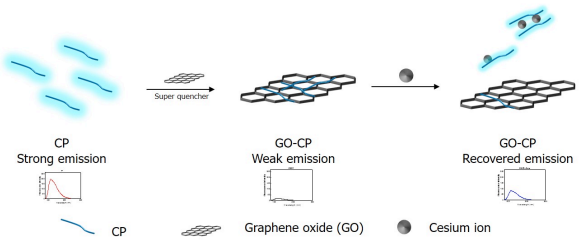

Figure 1: Representative mechanism of sensing Cs ion with GO-CP in aqueous solution.

References:

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Investigation of Potential Parameters Effect on Stable Structures of Pt–Pd Alloy Nanoparticles by Particle Swarm Algorithm

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Abstract:
Because the structure determines the chemical and physical properties, atomic-level understanding of structural features of bimetallic nanoparticles is of great importance to their syntheses and applications. In this work, we propose an improved discrete particle swarm optimization (PSO) algorithm to predict the stable structures of bimetallic nanoparticles. In this algorithm, the variable pair of 0 and 1 (which relatively represent the two atoms) is introduced to enhance the speed of searching optimization in the initial stages, and the simulated annealing operator is added to avoid premature convergence and trapping into local optimal solution. Tetrahexahedral Pd-Pt bimetallic nanoparticles containing 3285 atoms are used to test the effectiveness of the proposed algorithm. Furthermore, the proposed method is employed to investigate and compare the stable structures of the nanoparticles by changing some parameter of the Gupta potentials. The results have demonstrated the superior convergence of the proposed PSO algorithm in structural prediction of bimetallic nanoparticles. The comparison of the stable structures based on three groups of the parameters in Gupta potentials shows that for the parameter I, the structure is in best agreement with the experimental result. while for the parameter Ⅲ, the Pt-Pd bimetallic nanoparticle is most stable.

Keywords: Nanoparticle, Stable structure, Improved particle swarm algorithm.

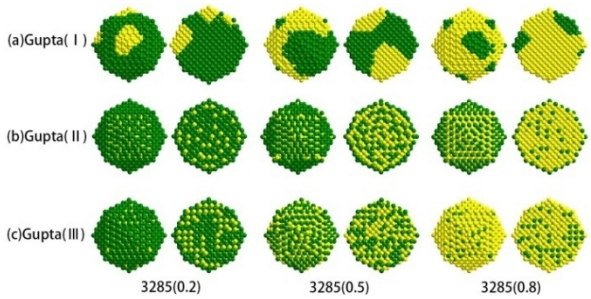

Figure 1: Optimal structures of Pd-Pt bimetallic nanoparticles with Pt compositions of 0.2, 0.5, and 0.8 for three different potential parameter groups. The first and second column represents the whole and cross-section atomic arrangements of the nanoparticles. Pt atom is in yellow and Pd in blue. This figure indicates that Pd atoms tend to be distributed in the outer layer of the nanoparticles with the increasing proportion of Pt atoms. The parameter set Ⅱ leads to layer-like segregation. However, the parameter set Ⅲ leads to form the mixing alloy structures.

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Electrical Properties of Hybrid Nanocomposites based on Reduced Graphite Oxide, Multiwall Carbon Nanotubes and Natural Rubber

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Abstract:
Electrically conducting polymeric materials such as nanocomposites containing electrically conductive filler nanoparticles has attracted large interest of scientific community. Composites based on polymers and graphitic fillers, such as multi-walled carbon nanotubes (MWCNTs) and reduced graphene oxide (RGO), have been highlighted in this field. MWCNTs and RGO are allotropic structures of carbon, which presents excellent electrical and mechanical properties. These properties can contribute to increase the electrical conductivity and the stiffness of polymers at very low filler content. The preparation of nanocomposites based on natural rubber (NR), namely, NR/RGO, NR/MWCNTs or by using a combination of these nanofillers NR/MWCNTs/RGO could result promising for obtaining electrically conducting elastomeric materials.
This work reports the study of electrical conductivity of nanocomposites prepared by mixing of NR latex with stable suspensions of RGO and MWCNTs. Stable suspensions of RGO and MWCNTs were prepared by using sodium dodecyl sulfate (SDS) as surfactant. The parameter for the preparation of these stables suspension was determined by study of the optimal ratio of RGO/SDS or MWCNTs/SDS and the concentration of RGO or MWCNTs in the suspension. The RGO was prepared by the oxidation of graphite by the method reported by Brodie. RGO (Figure 1) presents 9 stacked graphene layers as determined by XRD and an empirical formula of $C_{19}O$, while MWCNTs presents around 15 layers, length between 10-20 μm and an empirical formula of $C_{13}O$.
The nanocomposites filled with RGO showed that the percolation threshold was reached when the concentration of RGO was around 0.5 phr (phr, part per hundred rubber). In this case the composite presented an electrical conductivity of $5x10^{-3}$ S/m. On the other hand, the nanocomposites filled with MWCNTs showed that the percolation threshold was around 1.5 phr of MWCNTs, where the electric conductivity was $5x10^{-4}$ S/m. The use of a combination of RGO and MWCNTs as filler in the preparation of NR nanocomposite containing 2 phr of each filler allowed achieving conductivity of $2x10^{0}$ S/m. This indicated that the joint use of RGO and MWCNTs for the preparation of nanocomposites allows achieving higher values of conductivity than nanocomposites filled by either RGO or MWCNTs. The higher electrical conductivity observed when a combination of RGO and MWCNTs was used is attributed to the formation of electrically conducting interconnected filler network through the NR matrix.

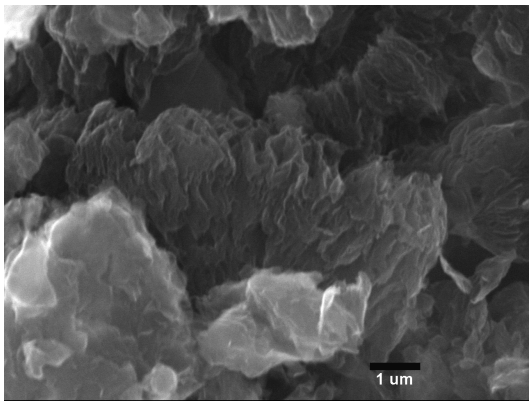

Figure 1: SEM image of RGO.

Keywords: Graphene, MWCNTs, Natural rubber, Nanocomposite, Electrical conductivity.

Acknowledgements: Financial support of Conicyt, Project Fondecyt Grant N° 1131139 is greatly acknowledged.

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Tunable Open Cavities: A Powerful and Versatile Tool for Exploring Light-Matter Interactions

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Abstract:
Polaritons, created by strong interaction between photons and excitons formed in nanoscale quantum wells, attract significant attention due to their interesting nonlinear behaviour such as non-equilibrium condensation, superfluidity and soliton formation. Strong polariton-polariton interactions may enable the effect of polariton blockade in strongly 3-dimensionally confined microcavities, leading to single photon emission [1]. We present a novel method to implement submicron polariton confinement with in-situ spectral tuning of the cavity mode. Our tunable cavity consists of a bottom semiconductor distributed Bragg reflector (DBR) with near-surface quantum wells (QWs) and a top dielectric concave DBR separated by a micrometer sized gap. Nanopositioners allow positioning of the DBRs to form a hemispherical cavity and the spectral resonance can be tuned by controlling the separation [2]. Reflection and transmission configurations of the device allows us to use both resonant and non-resonant laser excitation, while still being able to freely tune cavity length.
Due to the big range of cavity tunability it is possible to investigate cavity length influence on Rabi splitting with the same conditions without growing many samples and using non-resonant excitation. It was observed that Rabi is decreasing with increasing cavity length. Polariton condensation phase diagram dependence on different Rabi splitting was also investigated as shown in Figure 1 and it agrees with simulation very well.
Transmission configuration allows to use resonant excitation. Bistability of LG00 mode has already been observed, which opens possibility to investigate bistability dependence on Rabi splitting and negative or positive detuning. Many more experiments can be performed using tunable resonant excitation cavity, which was not possible before.

Keywords: polaritons, open cavity, phase diagram, quantum well, nonlinearity, bistability, resonant excitation, Rabi splitting, non-resonant excitation.

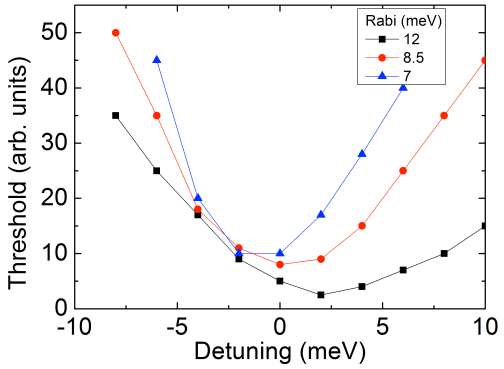

Figure 1: Figure illustrating the influence of different Rabi splitting on polariton condensation phase diagrams. Decreasing Rabi increases threshold, moves optimal threshold to more negative detunings and narrows parabola cones.

References:

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Intracellular Thermometry by Using Flourescent Carbon Dots

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Abstract:
Highly sensitive biocompatible photoluminescent (PL) thermometers on nanometer scale with non-sensitivity to physiological pH, ionic strength, probe concentration and local environment are urgently needed for accurate and reliable sensing of intracellular temperature, and offer significant application potential in various fields of biology and medicine. A number of the noncontact luminescence thermometers have been developed, including organic compounds, metal nanoparticles, rare-earth doped nanoparticles, polymer-based fluorophores, semiconductor nanocrystals and other inorganic and hybrid phosphores. However, these luminescent materials have their own drawbacks, such as low luminescence quantum yield, selective photoexcitation, high cytotoxicity, low biocompatibility, poor photostability and a general dependence of the luminescence properties on the local environment.

Carbon dots (CDs) have attracted increasing interest in many fields due to their intrinsic advantages, e.g. broad-band optical absorption, strong luminescence, superior resistance to photobleaching, high chemical stability, low toxicity and good biocompatibility. The recent reports on temperature-dependent photoluminescence intensity and dual emission of CDs and their hybrids show that they can be employed as a luminescence-based thermometer. However, these intensity-based or ratiometric nanothermometry approaches with CDs are sensitive to errors due to changes in a probe concentration, excitation power or a lack of specificity for temperature, and require calibration within the target environment to ensure accurate reporting. Such obstacles can be overcome using luminescence lifetime thermal sensing detection scheme, which is in many aspects superior compared to intensity-based measurements.

In our study, we demonstrate the application of CDs for *in vitro* intracellular temperature sensing, where the photoluminescence lifetime of CDs was adopted as a temperature-dependent variable. Highly luminescent water soluble N,S-CDs were synthesized by one-step hydrothermal treatment of citric acid and L-cysteine as precursors following the established protocol with minor modifications.[1] The PL lifetime allows an accurate determination of temperature, because it is independent of fluctuations under experimental conditions, such as the concentration of CDs or the intensity of the excitation source. More importantly, the obtained data prove an excellent applicability of CDs based nanothermometers for *in vitro* temperature sensing in human cervical cancer HeLa cells. Taking into account many other bio-advantages of CDs compared to other nanothermometers (water compatibility, low cytotoxicity, high biocompatibility, superior photo- and thermostability, extraordinary functional and concentration independency), we believe this study would open the doors for their applications in various biological, biochemical and medical disciplines where precise monitoring the intracellular temperature is required (thermal stress in plants, temperature assisted drug delivery/release etc.).

Keywords: carbon dots, photoluminescence, nanothermometer, intracellular temperature, luminescence lifetime thermal sensing, HeLa cancer cells.

References:

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Resent Advancement of Electromechanical propereties of metal oxide composites for supercapacitor

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Abstract:
Supercapacitors are unique energy storage systems that have been utilized in numerous fields. [1]. Supercapacitors can be categorized as pseudocapacitors and electric double layer capacitors (EDLCs) according to its energy storage mechanism. Large number of researches in this area has been concentrated on the evolution of several electrode materials as conducting polymers, different forms of carbon and transition metal oxides.

Among all these substances, Manganese oxide (MnO_2) has been visualized as a favorable supercapacitive substance because of its high electrochemical efficiency, low price, high capacitance, quick redox kinetics and more friendly to nature Inclusive researches have exhibited that manganese oxides are promising electrode substances for electrochemical supercapacitors. Pasting MnO_2 powders mixed with binders, deposition of thin films and conductive additives on conductive current collectors were the most common techniques that used for the fabrication of MnO_2 electrodes.According to literature, the reported experimental values of Specific Capacitance for MnO_2 films were in the range of [100 - 300] F/g. While the theoretical values were 1370 F/g which is so far from the reported values.

Graphene received enormous attention because of its unique properties for instances; powerful mechanical strength, high theoretical surface area and very good electronic conductivity.graphene-based substances can be obtained easily using straightforward chemical operation of graphite.

Zhu et al. have combined MnO_2 with nanostructured and nanometer-sized grapheme.They investigated morphology, chemical structure,synthesis, and electrochemical performances of MnO_2/Graphene nancomposite when using in supercapacitors as electrode materials.Results showed that specific capacitance at 0.5 A/g reached 210 F/g in aqueous electrolyte.

Maximizing the cell voltage and the specific capacitance could enhance the energy produced.

The cell voltage was enhanced by developing asymmetric supercapacitors. It's combined of capacitor-type electrode that represents the It's known also as electrochemical capacitors that demonstrate long cycle lifetime, fast charge and discharge rates and high power capability source of power and a battery-type Faradic electrode that represents the source of energy,

which offers the merit of both advanced batteries and supercapacitors in terms of energy density, cycle life, and rate [2].The Asymmetric supercapacitors take the advantage of the two electrodes usage to rise the operation voltage in the system, enhancing by that the energy density and the specific capacitance. Lately researchers have been developed different systems of asymmetric capacitor to increase the energy density, such as AC//graphite,
AC//polyaniline,AC//$Li_4Ti_5O_{12}$,AC//$Ni(OH)_2$,AC //MnO_2,AC//V_2O_5,carbon nanotube (CNT)//MnO_2.

MnO_2 is counted as one of the most remarkable pseudocapacitive substances for its extraordinary performance, low cost and availability in nature natural. Although MnO_2 electrodes have numerous advantages, there are some factors that limited its applications in the area of high power density supercapacitors such as; low conductivity and poor reversibility of the electrochemical oxidation/reduction of pure MnO_2. This paper will concentrate on the electromechanical properties of (MnO_2) metal oxide composites for supercapacitors such as; MnO_2,Graphene/MnO_2,MnO_2/Activated carbon and Graphene/MnO_2 with Activated carbon.

Keywords

Supercapacitors ,pseudocapacitors, electric double layer capacitors, metal oxide, MnO_2 films, nanostructured materials.

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Kinetics of the Acetins Production from Glycerol Esterification with Amberlyst-35 as Catalyst

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Abstract: The constant production of biodiesel from vegetable oil provides the market with a huge amount of glycerol, about 10% wt. of the production is raw glycerin as byproduct. The acetins production from glycerol esterification with acetic acid is studied to be used as fuel bio-aditives, being this an alternative for the raw glycerin use. This work aims to validate a heterogeneous rate equation, which represent the superficial interaction between the liquid compounds of the esterification reaction and the solid catalyst amberlyst-35. From literature, two possible mechanisms are considered for this reaction. The first one, the carbonyl group from acetic acid is protonated due to catalyst active sites, then the acylium ion is formed. The second mechanism, the formation of a tetrahedral intermediate takes place from the interaction between the glycerol and the acetic acid-active site complex. Then, the kinetic models are generated from the Langmuir Hinshelwood Hougen Watson method. Therefore, the sequential experimental design is used as methodology to make the kinetic study (Figure 1). This methodology consists of two steps. In the first one, discrimination among models is carried out using a divergence criteria and the relative probability of each model. When the most suitable model is chosen, in the second step, the kinetic parameters optimization is made based on the minimum volume criteria. The advantage of this method is to do the sufficient number of experiments to obtaining the appropriate model, this is why the use of resources and experimentation time is optimized. This work will provide the thermodynamic parameters and the kinetic constant in a heterogeneous rate equation.

Keywords: glycerol, esterification, heterogeneous catalyst, kinetics, sequential experimental design.

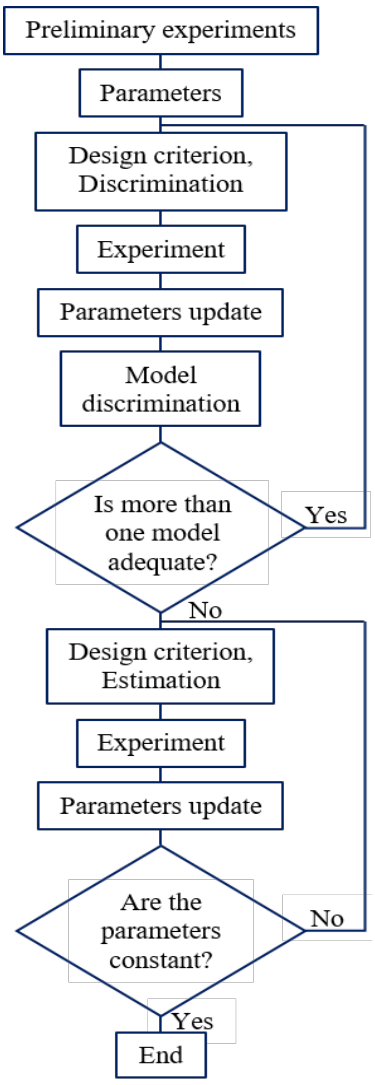

Figure 1: Sequential experimental design.

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High performance P-type transparent conducting oxide film by RF magnetron sputtering

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Abstract:
Optoelectronic device is one of the most popular electronics in our daily life. However, the lack of high performance P-type transparent conducting oxides (TCOs) presents a huge problem in many optoelectronic applications ranging from organic light emitting diodes (OLED) to transparent electronics. Oxychalcogenide is one of the most promising p-type TCOs among various types of oxides due to its recent outstanding results and complicated layered structure which allows more degrees of variation. It has the basic form of LnCuOCh, where Ln is normally rare earth element and Ch is chalcogen. In this work, highly pure layered oxychalcogenides, CuLaOS powders have been successfully synthesized by using solid-state reaction with the starting materials mixed stoichiometrically. Then, high performance P-type TCO film CuLaOS has been achieved by a radio frequency magnetron sputtering method, and various material properties including conductivity, activation energy and thermal stability have been examined. The stoichiometric CuLaOS has an optical band gap of 3.1eV which allows it to be highly transparent in visible light range. A sharp luminescence peak has been observed at the absorption edge at room temperature. The electronic structure and inter-atomic interaction were studied in detail by using X-ray photoelectron spectroscopy (XPS). The seebeck coefficient of CuLaOS was determined to be as high as 510μV/K. This work presents a detailed study of CuLaOS and the results demonstrate that CuLaOS is a promising P-type TCO material.

Keywords: Oxychalcogenide, P-type, transparent conducting oxide, RF sputtering, solid state reaction, thin film, layered structure, rare earth

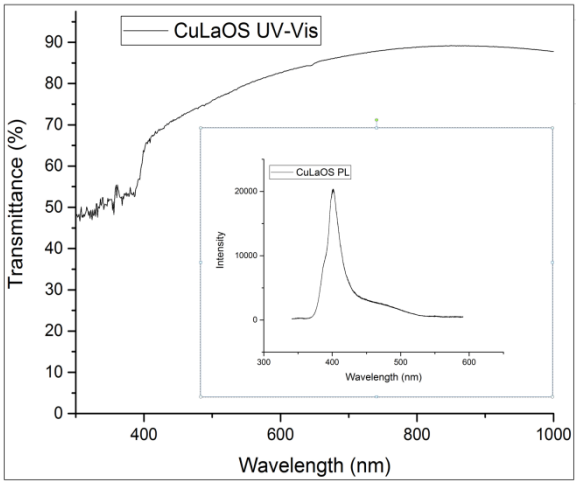

Figure 1: Figure illustrates the transmittance of the CuLaOS at different wavelength with an abrupt drop at 400nm wavelength which indicates an optical band gap of 3.1eV demonstrating superior transparency of this material. Inset gives the photoluminescence spectrum of the CuLaOS at room temperature where a sharp photoluminescence peak can be observed at 400nm.

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Structural Transformation of Titania Induced by High Energy Ball Milling

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Abstract:
The structural evolutions of micro and nano-scaled anatase TiO_2 powders have been investigated after vibratory ball milling at ambient temperature. The effects of milling on the TiO_2 band gap were also explored by applying Kubelka-Munk equation on the UV-visible diffuse reflectance spectra. This study reveals that mechanical ball milling induces phase transformations in TiO_2 from anatase (tetragonal) to titanium dioxide (orthorhombic) then to rutile (tetragonal). TiO_2 nanoparticles were more resilience towards phase transformation compared to microparticles. Within 0.5 hours of milling, the orthormbic phase began to emerge in the bulk powder then completely transformed to rutile after 6 hours. On the other hand no change in crystal structure of the nanopowder was observed after 0.5 hours and it took 9 hours to fail into a rutile phase. Both micro and nano powders experienced a shift in band gap towards visible region by 0.28 and 0.23 eV, respectively after 6 hours of milling.

Keywords: nano-scaled anatase TiO_2, vibratory ball milling, Kubelka-Munk equation, mechanical ball milling, titanium dioxide

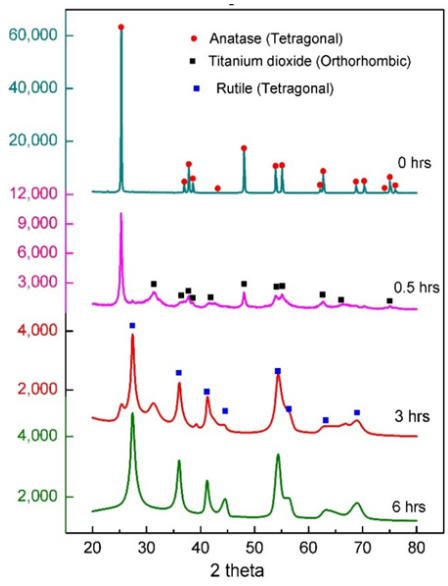

Fig.1. XRD patterns for as received TiO_2 after ball milling for 0, 0.5, 3 and 6 hours. complete phase transformation was obtained after 6 h and crystallite size has been decreased to 10.28 nanometer

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Preparation, Characterization and Catalytic Activity of Rare Earth Metal Oxides Modified Nanogold Supported $CeZrO_2$ Catalysts

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Abstract:
In order to meet practical requirements of chlorine-free benzaldehyde (BzH) for perfumery and pharmaceutical industries, vapor phase oxidation of benzyl alcohol (BzOH) has been extensively investigated. The limitation of this process is loss of carbon due to total oxidation of a part of benzyl alcohol (BzOH) into carbon dioxide at high temperature. Therefore, the liquid phase oxidation of BzOH into BzH at lower reaction temperature is more convenient [1]. Direct oxidation of BzOH in liquid phase is a promising route for the manufacture of BzH, because it completely overcomes the major drawbacks of as above mentioned. As oxidation activity is related to the increase of mobile oxygen share in active species, ceria zirconia (CZ) is known to have relatively high mobile oxygen atoms. The CeO_2-ZrO_2 mixed oxide has been shown to be very durable, even in the high temperature, hydrothermal environment. It is obvious that introducing new ions in the $CeZrO_2$ matrix will have an effect on the catalytic properties of these materials by enhancing the redox properties of the material or by improving its textural properties. It was found that doping $CeZrO_2$ with isovalent or aliovalent rare earth dopants can increase the catalytic activity of these matrials in oxidation of carbonaceous particular mater using oxygen. Texture and bulk properties of the prepared catalysts were characterized by different physicochemical techniques. $Ce_{0.5}Zr_{0.5}O_2$ showed is slightly active, but ehancement in the catalytic activity was observed when the catalyst deposited with 0.5 wt% gold nanoparticles. Further improvement in catalytic activity was observed with gold supported rare earth metal oxide (Sm and Dy).

Keywords: oxidation; rare earth metal oxide; ceria-zirconia;, gold nanoparticles; benzyl alcohol.

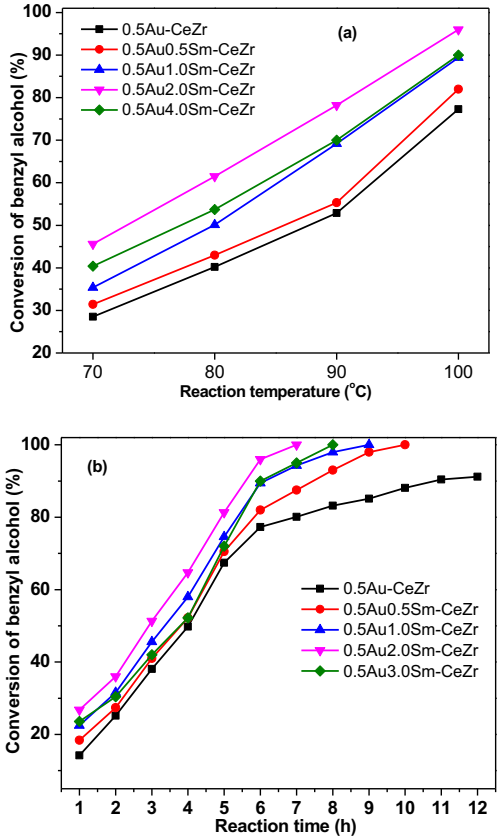

Figure 1: Effect of (a) temperature, and (b) time on the oxidation of benzyl alcohol over $Au_{0.5}Sm_x$-CeZr catalyst.

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Influence of Mechanical Parameters on the Tribological and Thermal Behaviors of Steel-Composite Carbone/Carbone Couple

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Abstract:
The tribological and thermal behavior of dry sliding contact steel composite carbone/carbone and steel-organic matrix composites are studied according to the parameters normal load, sliding speed, friction coefficient and test time. In the case of automotive braking, using a mathematical model, the surface temperature of contact was determined. Four normal forces, four sliding speeds and four friction coefficients were applied in this study. These parameters have a significant influence on the variation of average contact temperature. The results illustrate the evolution of the contact temperature according to the braking time.

Keywords: Temperature, Friction, Steel, Composite, Disc, Trim.

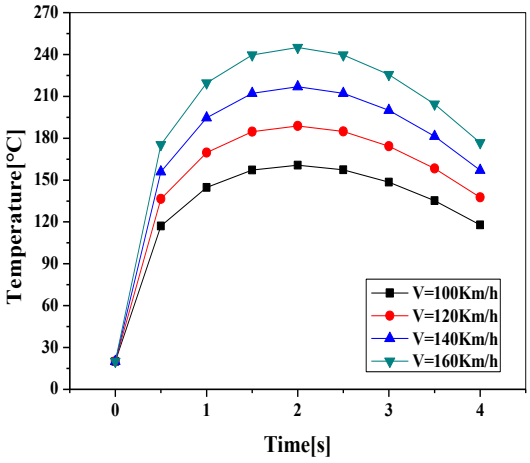

Figure 1: Evolution of contact temperature for the couple: (a) steel- composite carbon-carbon, (b) steel- composite organic matrix according to time: p = 10 [KN] and μ = 0,27.

precursors on the parameters affecting the conformation, biological activity and functionality of encapsulated biomolecules.

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Study of microscopic and thermal properties of iron-based powders obtained by high-energy ball milling of Calamine

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Abstract:
This study was carried out with an intention to prepare iron-based powders from metallurgy industry waste called Calamine. The latter consists of oxides scale formed on the surface of hot rolled steel. The mechanical alloying process used in this work is high-energy planetary ball mill.
Morphological and thermal shifts of the milled oxides scale powders were characterized by optical microscopy, scanning electron microscopy (SEM), thermogravimetric analysis (TGA) and differential thermal analysis (DTA).
The results showed that the oxide scale contains more than 98% of iron.

Keywords: Calamine, iron-based powders, mechanical alloying, scanning electron microscopy, thermal analysis.

Table 1. Chemical composition of examined and steel procuced

Elem	Si	Cr	Mn	Mo	S	C	Fe
Oxide scale	0.248	0.072	0.392	0.014	0.039	0.018	Bal
Steel	0.350	0.100	0.850	0.100	0.015	0.085	Bal

References:

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Application Finite Element Method for Temperature Distribution In a fil

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Abstract: In recent decades, the increasing use of composite materials (resulting from the combination of a fiber reinforcement (carbon or glass) and a matrix), are very successful with major industrial sectors. Include primarily the areas of transport, such as automotive, aerospace or rail, this success lies in the numerous advantages of these materials; they allow, for example, the shaping of complex parts while reducing the number of interfaces (bolting, riveting or the solder on metal structures) [1] They also exhibit improved resistance to mechanical stresses and increased resistance fatigue. Their low density is also an advantage when the relief structures is a priority and take paramount in scientific research.

In this communication, the CND approach that involves the heat induction in passive parts to control the after operation has subsequently allowed the creation of many systems based on the use of lights, lasers, heat guns. These systems create a thermal imbalance in controlled rooms; can then analyze the dissipation of heat which will be disturbed by any mechanical inhomogeneity (discontinuity of the material, thickness variation, ...) [2, 3,4]. This excitation is global, and as far as homogeneous as possible throughout the part to be inspected. The surface temperature distribution in a given environment can provide information on the thermomechanical properties and the presence or not of mechanical defects in the material (detection and localization). In this context we seek to determine the sources applied in a one-dimensional medium knowing the temperature maps at different times. The method relies on a space-time discretization of the 1D heat equation for writing the problem in its matrix form.

First we solved the direct problem by Numerically method of finite elements.

Keywords: protein folding, nanoporous sol-gel glasses, silica-based biomaterials, circular dichroism spectroscopy, surface hydration, crowding effects, micropatterning, biomedical applications.

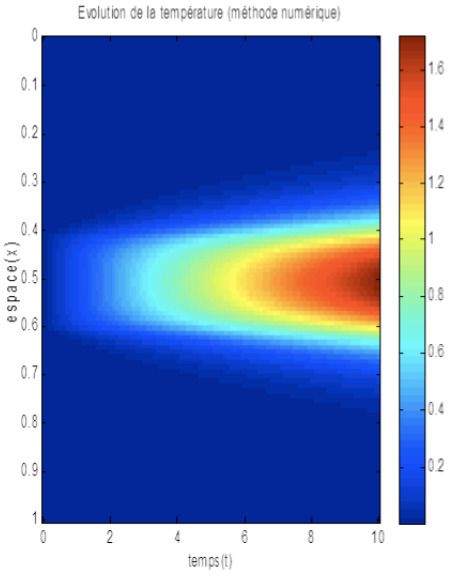

Figure 1: Représente la répartition de temperature (in Kelvin) as a function of space (takes time (s), for which no space is 0.01 and a time step of 0.1.

It is found that the heat is distributed within known wire or over time. Of course the temperature obtained is related to the ambient temperature taken as reference.

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Posters Session II. A :
Nanomaterials for Water treatment and Environment / Nano Electronics

Highly sensitive nano-based touch sensor for robotics applications

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Abstract:
Robotic arms have significant presence in different processes of manufacturing. These arms needs to have the ability to sense the environment around. Construction of robotics that moves like humans with respect to precision, agility, and stability, is a prerequisite for integrating robotic systems successfully [1]. One of the major sensors is the touch sensors that provide contact information from the surrounding.
The proposed touch sensor in this paper can sense the presence of object when contacting. Furthermore, when the robot hold an object to carry, a certain power should be applied in order not to break the object or let it fall, this certain power could be detected using the sensor as the amount of the generated current depends on the pressure value applied.
The sensore composed of piezoresistive thin film transistor (tft) with piezoelectric harvester to generate the gate voltage of the tft. Piezoresistive sensors have DC input, simple conditioning circuits and higher output in comparison to capacitive sensors [2].
The piezoelectric layer is first to receive the impact and generates an output voltage at its farther end due to the mechanical deformation. This voltage is conducted by the gate fractal layer, and the piezoelectric voltage can be measured between the gate electrode fractal and the grounded bottom electrode. The insulating oxide layer is introduced in order to isolate the gate from the piezoresistive layer and ensure that no current conduction occurs between the gate and the source or the drain. The source pattern from the top layer is grounded and the application of load along with the gate voltage and piezoresistive effect generates a voltage as well as a current between the drain and the source fractal patterns within the top fractal layer. These two parameters count as the output of the self-powered nano-device.
There are three different stages with different energy conversion processes: mechanical to electrical, electrical to mechanical and mechanical to electrical. The piezoelectric layer converts mechanical energy to electrical energy as voltage on the gate layer. When the gate conducts the voltage to the piezoresistive layer, it transforms the electrical energy to mechanical energy that induces the layer to produce a current between the source and the drain. Figure 1 shows the conversion of energy between layers.

Keywords: piezoresistive, piezoelectric, touch sensor, micro robots, harvester.

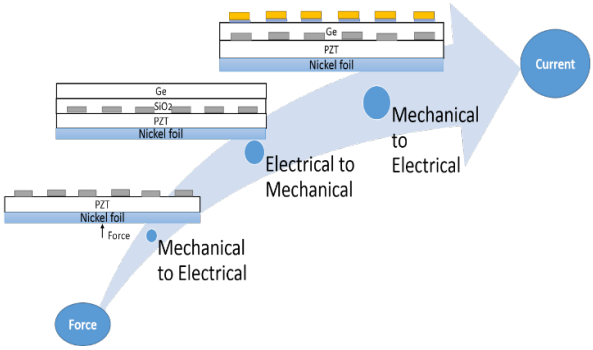

Figure 1: Energy conversion between layers of the device.

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Electronic and Structural Properties of V-doped CdTe semiconductor in ZB Phase

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Abstract:
Using full-potential calculations based on density functional theory with the generalized gradient approximation, we studied the structural properties and electronic structure of $Cd_{1-x}V_xTe$ alloy with x=0.03. The equilibrium structural parameters are determined from the total energy minimization. The calculated band structures reveal that V-doped CdTe is a half metallic ferromagnetic compound. The effect of V magnetic impurity introduced in CdTe is discussed.

Keywords: DFT, semiconductor, ferromagnetic, band gap, CdTe, hydrostatic pressure.

HIGH PERFOMANCE ASYMMETRIC SUPERCAPACITOR BASED ON MoS2/GF AND ACTIVATED CARBON

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Abstract:
Carbonaceous materials, like graphene, carbon nanotubes and activated carbon are generally being used as negative electrode due to their good rate capacity, high surface area, low cost and facile synthesis procedure[1,2].Transition metal chalcogenides such as Cobalt sulphide[3], molybdenum disulfide[4] and Nickel sulfide[5] and copper sulfide[6] are potential electrode materials for supercapacitor applications because they are known to be electrochemically active with good electrochemical performance. Molybdenum disulphide which has a graphene-like single layer structure has attracted great interest in phototransistors, catalysis, lithium ion batteries and supercapacitor applications due to its excellent mechanical electrical properties and unique morphology[7,8] .Molybdenum disulphide comprises of covalently bonded S-Mo-S atoms which are held together by weak van der Waals forces[9,10].However MoS_2 has low electrical conductivity during the assembly process which may lead to lower electric-ionic diffusion rate and lower effective interaction between electrode and electrolyte.It has been established that modifying the MoS_2 with carbon materials to obtain a composite material is one of the most effective means of increasing the conductivity as well as its electrochemical properties[11,12]. Graphene –one atom thick wonder material with excellent electrical conductivity, good stability can provide interconnecting mesostructured supports that can facilitate good nanoparticle dispersion and electron transport for MoS_2.

In this work pure MoS_2 and MoS_2/graphene foam (GF) with different graphene foam loading were synthesized by hydrothermal process to improve on the specific capacitance of the composites. An asymmetric supercapacitor were fabricated using the best performing Mos_2/GF composite and activated carbon derived from expanded graphite (AEG) as positive and negative electrodes respectively in an aqueous electrolyte. The hybrid material composite demonstrated a high rate capability when related with a pure MoS_2 electrode. The MoS_2/GF //AEG asymmetric supercapacitor could perform reversibly at a high cell voltage of 1.4 V in 6M KOH delivering high energy and power densities of 51 Wh kg^{-1} and 1765 W kg^{-1} at current density of 0.5 A g^{-1} respectively. The supercapacitor also displayed a good cyclic stability with 95 % capacitance retention over 2000 constant charge discharge cycles.

Keywords: MoS_2, Activated carbon from expanded graphite, Graphene foam, Asymmetric supercapacitor

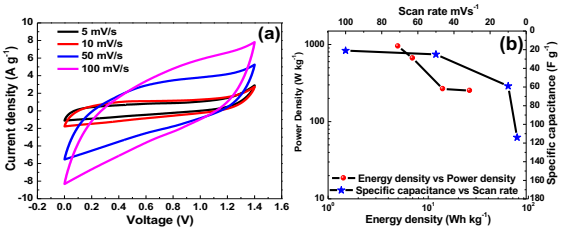

Figure 1:(a) Cyclic voltammetry of asymmetric MoS_2/GF //AC device at scan rates of 5 –100 mV s^{-1} and (b) Ragone plot and the specific capacitance as function of the scan rates respectively.

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Novel Nanocomposites for heavy Metal Ions Removal from Water

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Abstract:
Magnetic cobalt ferrite (CF), titanate nanotubes(T) were prepared via coprecipitation and hydrothermal method respectively, and magnetic beads (CG), titanate beads (TG) nanocomposites were prepared via "gelation method" (figure1). The results of X-Ray Diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR), Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), and Vibrating Sample Magnetometer (VSM) showed a successful preparation of adsorbents. Their application as superior adsorbents for Fe(III), Cu(II) and As(III) were also explained. The effect of pH, initial heavy metal ion concentration, contact time, and weight of adsorbent on the removal effeciency of heavy metal ions from water were studied. The optimum pH was found to be 6.5, the optimum contact time was found to be 2 h and the optimium weight of adsorbents were found to be 0.15 g. The removal efficiencies of CF, T, CG and TG were found to be 100 %, 100%, 60% and 82% for Fe(III), respectively. The CF, T, CG and TG have removed almost 100 %, 99%, 95% and 98% of Cu(II), respectively. Reasonable and insignificant removal efficiencies (77%, 95%, 10% and 32% for CF, T, CG and TG, respectively) of As(III) were recorded. The collected equilibrium data were also fitted to both Langmuir and Freundlich isotherms for all the prepared materials. This study revealed that the beads nanocomposites were efficient adsorbents for the removal of Fe(III) and Cu(II), but they were not efficient for the removal of As(III) from water.

Keywords: Heavy Metal Ions, Adsorption, Cobalt ferrite, Titanate, Gelation Method, Magnetic beads, Nanocomposites.

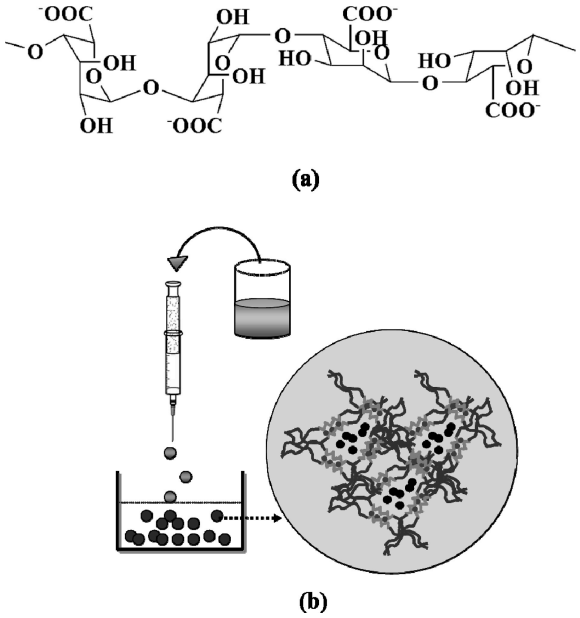

Figure 1: (a) Chemical structure of alginate polymer and (b) schematic illustration for the fabrication of the magnetic and titanate beads.

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Detection of Defects in the Materials by Using the Heat Equation

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Abstract:
We propose a numerical study of heat transfer whose objective is to detect defects in a solid material in the presence of the fault, and see how the fault influences the transfer of heat by the variation in temperature in a solid material. The finite difference method has been used to solve the governing equations. The numerical simulations were made for a wide range of thermal conductivity numbers ($0.1 \leq \lambda \leq 25$), and the temperature of the walls in order to determine a correlation that connects the temperature according to the thermal conductivity for different materials.

Keywords: detect defects, solid material, finite difference method

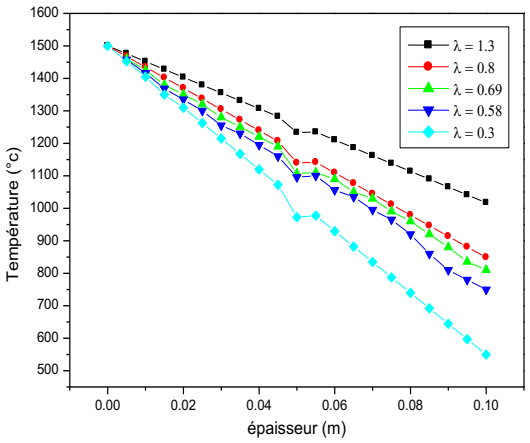

Figure 1

Figures 2, 3 shows the variation of the temperature of the material as a function of the thickness, it is noted that the temperature decreases with the decrease in thermal conductivity: for =0.3 the temperature is decreased until,549.6°c, for =0.58 the temperature is decreased until, 750.1°c for =0.69 the temperature is decreased until, 810.4°c for =0.8 the temperature is decreased until, 848.78°c, and for =1.3 the temperature is decreased until, 1017.3°c.

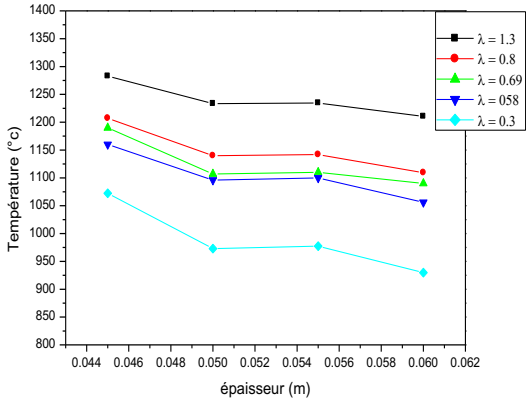

Figure 2

We note that the temperature profile has a gradual and uniform distribution descending from the surface, but when we get closer to the center we see that the distribution is disturbed, and We note that there is drop in temperature at the crack due to the temperature difference between the material and the default..

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Posters Session II. B : Nanotechnology for Life science and Medecine

Nanostructured surfaces of solid substrates for bio-applications

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Abstract:
A number of materials studied in materials research and in bio-applications (polymers, glass, silicates) have a wide range of interesting properties, but their use is often limited to certain applications due to inappropriate surface properties. Particularly for bio-applications are very important surface properties like chemistry, surface charge, morphology and porosity of the materials studied. Therefore, we focus on the possibility of modification of the surface properties so that they are suitable for pre-planned applications. The aim of work is to modify the surface and surface properties of different substrates. Make it suitable for bio-applications, namely to: be useful for adhesion and proliferation of cells, or to exhibit antibacterial effects.
We have modified surfaces of polymers by chemical and physical methods, for examples activate with plasma or with Piranha solution, we studied the resultant changes of surface properties of the modified substrates. The activated surfaces were grafted with selected vicinal compounds and then with some boron cluster compounds - highly fluorescent boron hydride cluster *anti*-$B_{18}H_{22}$ or its thiolated derivative 4, 4'- $(HS)_2$ -*anti*-$B_{18}H_{20}$. After grafting we used many analytical methods and made antibacterial tests of *E.coli* or inhibition of algae growth tests of *Desmodesmus quadricauda*.

Keywords: polymer, Piranha solution, surface chemistry, bio-applications, antimicrobial tests

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Acknowledgement:
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Extraction of Chilean Alginate and Preparation of Alginate-PCL Fibers Through Electrospinning

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Abstract:
Alginate (ALG) is a natural biopolymer composed of ß-D-mannuronic acid (M) and α-L-guluronic acid (G) co-units monomers. ALG is a biocompatible, exhibits low toxicity, has low cost and shows mild gelation by the addition of divalent cations. Our group has extracted ALG from Chilean algae *Lessonia nigrescens* and *Lessonia Trabeculatay* genus. Recently, we have shown that they have promissory results in clinical applications for cell therapy. We have also evaluated the effect of ALG from *Lessonia nigrescens* as template for $CaCO_3$ crystals obtained by an electro-crystallization method. The morphogenesis of different $CaCO_3$ crystals was characterized by XRD and SEM.
Herein, we report the preparation of electrospun fibers using Chilean alginate from *L. nigrescens* and *L. trabeculatay* genus through electrospinning. Our preliminary results show that particles and structured fiber of Chilean ALG can be successfully produced by electrospinning using PEO and surfactant at 1wt-%, 10wt-% and 15wt-% (Figure 1a). On the other hand, electrospun ALG-PCL fibers with core-shell morphologies at 15 wt.% (Figure 1b) and 6 wt.% were performed with *L. nigrescens* and trabeculatay, respectively.
The PCL was purchased from Aldrich and the ALG was extracted from commercial *L. nigrescens* and *L. trabeculatay* genus in the Polyforms lab®. For all electrospinning essays an eStretching LE-10 Fluidnatek® instrumente was used. In summary, we got electrospun ALG and ALG-PCL fibers using Chilean marine resources in order to contribute to the design, development and manufacturing of future hybrid biomaterials for biomedical applications in Chile.

Keywords: alginate, crystallization, encapsulation, *Lessonia nigrescens*, *Lessonia trabeculatay*, electrospun fibers, electrospinning.

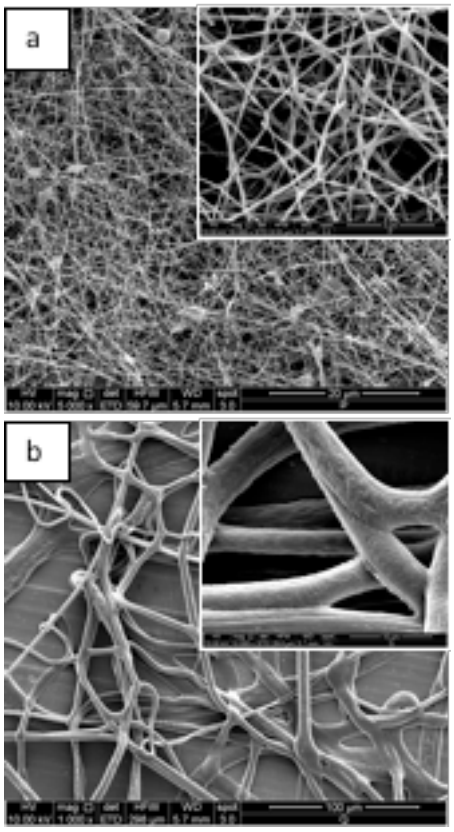

Figure 1: Electrospun fibers of Chilean alginate a) from *L. nigrescens* at 15 wt.%, b) ALG-PCL fibers with core-shell morphologies at 15 wt.%.

Acknowledgments

Fondecyt 1140660, Fondap 15130011 and Program U-Redes, Vice-presidency of Research and Development, University of Chile.

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Advanced Plasma Treatment of Single-walled Carbon Nanotube for more Creation of Functional groups to Immobilize Biomoleculars

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Abstract:
It is mightily important to have the high sensitivity and immobilization efficiency in biosensor. We found the advanced plasma treatment method for increasing the sensitivity of electrochemical sensors and enhancing the immobilization efficiency of relatively large biomolecular. Although a few studies have introduced the single-walled carbon nanotube (SWCNT)-based sensors [1,2], the poor efficiency of treated SWCNT device could have been due to a number of technical issues. One possibility is insufficient cleaning of Dichlorobenzene (DCB) byproducts, sonopolymer, during spray-coating, which can mask the surface of SWCNT electrode thus preventing adequate antibody immobilization and effective charge transfer between electrode and biomolecules [3]. Therefore, complete removal of DCB byproducts would be critical for the creation of functional groups on the SWCNT film because of the providing a stronger interaction between SWCNTs and biomolecules.
We measured the analytical performance characteristics of the two-step O_2 plasma treated SWCNT electrodes-immobilized with anti-CD4 antibody. The representative peak currents of one- and two-step treated electrodes were present at 0.29 V (Figure 1a) and averaged as shown in Figure 1b. These peak currents were 0.0763 μA and 0.3263 μA, respectively, demonstrating that the two-step treated electrode had an approximately 4.28 times larger current than the one-step treated electrode. Since the sensor signal can be greatly affected by the quantity and stability of immobilized biomolecules on the surface of the electrode, the high level current associated with the two-step O_2 plasma-treated electrode indicates a larger amount of immobilized anti-CD4 mAbs and a faster charge transfer on the SWCNT electrode than those on the one-step O_2 plasma-treated electrode.

Keywords: single-walled carbon nanotube, dichlorobenzene cleaning, two-step O_2 plasma treatment, CD4 T cell, immunosensor.

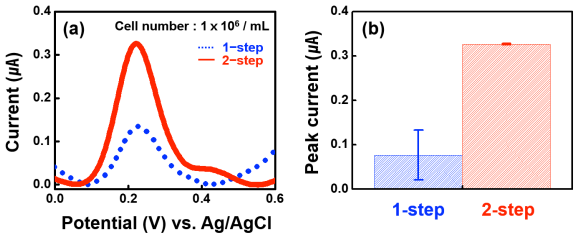

Figure 1: Comparison of capture efficiency following one- and two-step O_2 plasma treatments of SWCNT immunosensors.

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Targeting Leukemic Cells with Iron Nanowires

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Abstract:
In the field of nanomedicine, there is a strong need for the development of smart nanoparticles that target specific cells, due to their therapeutic potential and biomedical applications. Iron nanowires are a new type of nanoparticle in the field of cancer treatment. They are highly biocompatibility and easy to coat with different biological agents. Their magnetic and shape anisotropy allow multifaceted remote manipulation, rendering them versatile nanorobots. Studies showed that these NWs can be used to induce death in cancer cells. The aim of this study is to functionalize iron NWs with anti-CD44 antibodies, a cell surface marker that is express much more in Leukemic cells than normal blood cells, in order to target leukemic cells and develop new approaches for treatment.
Iron NWs were electrochemically fabricated with an average diameter of 50 nm and a length around 4 µm. They were coated with bovine serum albumin (BSA) in order to conjugate them with an anti-CD44 antibody via a covalent bond between the antibody and the amine group in the BSA (1-Ethyl-3-3-dimethylaminopropyl-carbodiimide and N-Hydroxysuccinimide coupling) **Figure1.** In order to confirm the CD44 antibody maintained antigenicity after binding to the NWs, immunoprecipitation and western blot were used. In addition, cytotoxicity effects of both anti-CD44-iron NWs and bare iron NWs were studied by using (2,3-Bis-2-Methoxy-4-Nitro-5-Sulfophenyl-2H-Tetrazolium-5-Carboxanilide) XTT assays, showing a high level of biocompatibility.

Keywords: Iron - Nanowires - Bovine serum albumin (BSA) - Coating - DC44 antibody - functionalization.

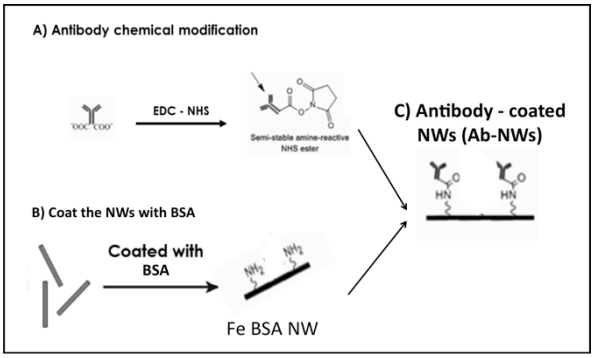

Figure 2: The figure illustrating the coating and functionalization process of iron NWs.

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Utilising Novel Nanoparticles for DNA Vaccine Delivery

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Abstract:
Most DNA vaccines are effective in eliciting immune responses without any side effects. The main criterion for a successful DNA vaccine is to have an efficient delivery system which can deliver it safely to the target cells. There are several successful delivery systems for DNA vaccines til date; however no standard system is in place. For effective DNA vaccination, targeting antigen presenting cells would be important. In this proof of concept study two novel delivery systems 1) Solid Lipid Nanoparticles (SLNs) and 2) yeast transposon virus like particles (Ty-VLPs) were chosen to study their potential to carry DNA vaccines *in vitro* to dendritic cells using eGFP plasmid as the reporter plasmid. Positively charged solid lipid nanoparticles were synthesised by modified solvent-emulsification method and conjugated with plasmid DNA to form complexes (SLN-DNA complexes). Integrity of these complexes was confirmed by various agarose gel based assays. The complex formation is based on the electrostatic interation between the SLNs and DNA (Figure 1). The SLN-DNA complexes were transfected into DC 2.4 cells and analysed by flow cytometry for GFP expression. It was shown that there is a 10 fold increase in the transfection rate using these complexes in DC 2.4 cells over plasmid alone and is comparable to that mediated by lipofectamine. Short term stability study data suggested the suitability of these formulations for pharmaceutical applications. On the other hand, Ty-VLPs were purified and plasmid DNA conjugated with them. The transfection efficiency of these complexes was shown to increase compared to plasmid alone. In comparison SLN system was more efficient for DNA delivery than Ty-VLP system.

Keywords: DNA vaccine delivery, Solid lipid nanoparticles, flow cytometry, *in vitro* transfection, dendritic cells, pharmaceutical potential.

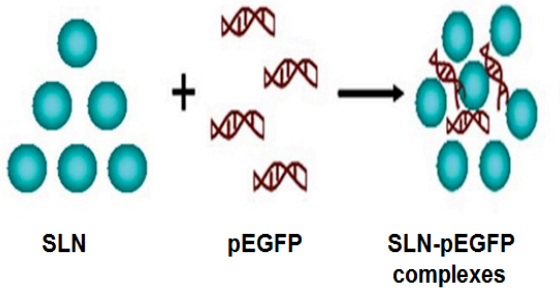

Figure 1: Schematic representation of the probability of SLN-DNA complex formation. The cationic SLNs interact with anionic DNA by electrostatic force of interactions.

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Surface coated chitosan nanoparticles for the modulation of the protein corona

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Abstract:

Understanding the interactions of nanoparticles (NPs) with serum proteins is a critical issue in the development of targeted nanomaterial delivery. The composition of the protein corona formed by hyaluronic acid (HA) coatings on the surfaces of chitosan NPs (CS-HA NPs) was investigated. Non-decorated (CS NPs) and alginate-decorated NPs (CS-Alg NPs) used as controls.

NPs were synthesized and incubated with bovine serum to form the NP-protein coronas. All prepared NPs were characterized via dynamic light scattering (DLS) to determine their sizes, zeta potentials, and the polydispersity index (PDI). Proteome-mapping techniques that include one-dimensional gel electrophoresis, liquid chromatography, and tandem mass spectrometry were performed to report the proteomics analysis. Data were subjected to the proteome discoverer software and proteins identified and then annotated based on their function by the Uniprot GO classification.

Zeta potential of non-coated NPs were largely positive, with reasonably narrow distributions. However, adsorption of both polyanions (HA or Alg) reversed the NPs charge density from cationic to anionic. Coating CS NPs with HA increased the size of NPs, possibly due to a very moderate agglomeration during the coating process. CS-Alg NPs showed significantly higher positive charge density and significantly larger size particles. Our results shows that HA significantly reduced protein deposition relative to both CS and CS-Alg NPs, which could be attributed to its relatively moderate negative charges.

Higher number of different proteins was identified from CS-Alg NPs as opposed to CS or CS-HA NPs. While all nanoparticles have shown affinities to some essential components of the complement pathway such as complement C3, unique protein signatures were identified that were specific to CS, CS-HA, or CS-Alg NPs. Such differential protein adsorption might determine the circulation fate of targeted nanomaterial delivery. Modulating NP-protein interactions is of essence to allow nanomaterials to access target locations for diagnostic or therapeutic gain.

Keywords: Nanoparticle, chitosan, hyaluronic acid, corona, proteomics.

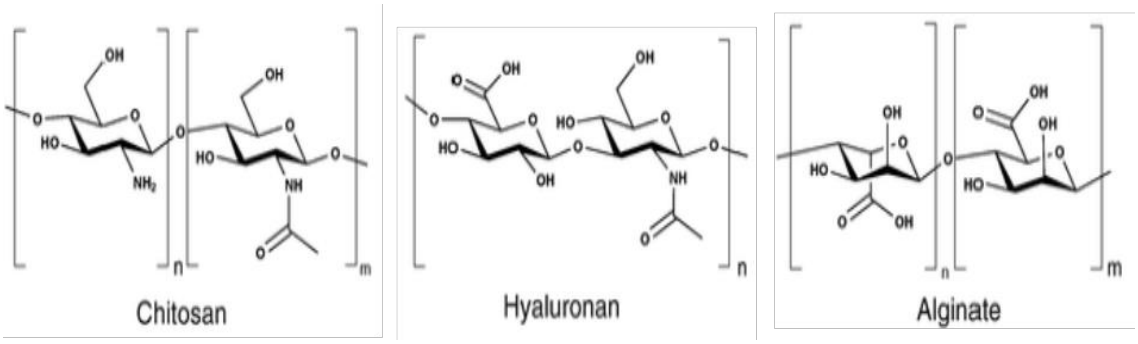

Figure 1: Figure 1. Chemical structure of polysaccharides used in this study. Chitosan, the N-deacetylated derivative of chitin is composed of beta (1,4)-N-acetyl-D-glucosamine and D-glucosamine. Hyaluronan is composed of alternating beta-(1,4)-D-glucuronic acid and b-(1,3)-N-acetyl-D-glucosamine. Alginate is composed of alternating blocks of beta-(1,4)-D-mannuronic acid and alpha-(1,4)-L-guluronic acid.

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Garlic nanoemulsions intended for broiler growth performance

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Abstract:
Essential oils (EOs) have gained attention from the swine and poultry industries as an alternative replacement to antimicrobial growth promoters (AGPs) as they pose a threat to animals and human health. However, EOs are not simple compounds, preferably a mixture of various compounds (mainly terpenes and terpene derivatives), with concentrated hydrophobic liquids containing volatile aromatic compounds. Hence, the aim of this study was to develop garlic nanoemulsions (GN) using Taguchi experimental design and emulsification method. Surfactant concentrations, mixing ratio, type of surfactant and stirring speed were selected as important factors affecting the droplet size and PDI of the GN. All factors showed an effect on the particle size and PDI for the preparation of GN. The predicted results and the experimental results had a small difference, yielding a small mean droplet size of 28.41 nm with PDI of 0.315, a zeta potential of 28.5±1.15 mV, a viscosity of 39.45±1.62 mPa.s and density 0.9859±1.34 g/cm³. The compatibility of the garlic essential oil and Tween® 80 was ascertained by FTIR, which indicated that there was an insignificant interaction between the oil and surfactant. The GC-MS showed the presence of the important compounds of garlic in GN. An antimicrobial and antioxidant activity of GN showed an improvement when compared to garlic essential oil. Taguchi L-9 approach showed to be an easy and useful tool to optimise the various parameters for preparation of GN. The results obtained showed that GN can be a potential replacement for broiler growth performance.

Keywords: Antimicrobial growth promoters, Essential oil, Garlic, Nanoemulsions, Taguchi method

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