



International Conference & Exhibition
16 – 18 March 2015
JW Marriott Marquis Hotel
Dubai – UAE

Organizer



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Nanotech Dubai 2015 Conference Program

16 March 2015

Session I: Nanomaterials Fabrication, Characterization and Tools/ Properties

Room MAJLIS II

Session chairs:

Prof. Taleb Ibrahim- UAE/ Prof. Mohammad Reza Ejtehadi - Iran

9:00-9:45	Emerging Nanotechnologies: Status Quo A. Kelarakis	Dr Antonios Kelarakis , University of Central Lancashire, United Kingdom
9:45-10:30	Synthesis and Characterization of Alkaline Earth Nano-materials for the Preservation of Cultural Heritage Artifacts K. Saoud	Prof Khaled. Saoud , Virginia Commonwealth University in Qatar, Qatar .
10:30-11:00	Coffee Break + Exhibition	
11:00-11:45	Supercritical Fluid Technology for Fabrication of Nanomaterials S. Khapli and R. Jagannathan	Prof Sachin Khapli , New York University Abu Dhabi, Abu Dhabi, United Arab Emirates
11:45-12:00	Structural characterization of materials at the nanoscale: the XRD issue P. Lecante	Dr Pierre Lecante , Centre d'Elaboration de Matériaux et d'Etudes Structurales, Toulouse, France
12:00-12:15	Diameter-controlled synthesis of SWNTs for high performance devices F.Z. Bouanis , C.S. Cojocar, V. Huc, E. Norman, M. Chaigneau, J.L. Maurice, T. Mallah and D. Pribat	Dr Fatima Zahra BOUANIS , Ecole Polytechnique/IFSTTAR, France
12:15-12:30	Synthesis and characterizations of GDC nanowires by wet chemical route for LT-SOFC V.D. Bhargavi, K.K. Tanwar , P.H. Kumar, N. Jaiswal, O. Parkash and D. Kumar	Mr Khagesh Tanwar , Indian Institute of Technology (BHU)- Varanasi, India .
12:30-14:00	Lunch Break + Exhibition	

Session I: Nanomaterials Fabrication, Characterization and Tools/ Properties

Room MAJLIS II

Session chairs

Dr. Matteo Chiesa – UAE / Prof. Khaled Saoud - Qatar

14:00-14:15	Synthesis and characterization of controlled ZnO nanorods lengths I. Musa , N.Qamhie, and S. T. Mahmoud	Dr Ishaq Musa , United Arab Emirates University, Al-Ain, United Arab Emirates
14:15-14:30	Preparation of Copper Oxide Nanofluid by Sol- Gel method Quraish A. Kadhum , Kassim M. Sahan , Riyadh M. Noaman and Alaa A. Naji	Mr Kassim M. Sahan , Renewable energy director, Ministry of science and technology, Iraq
14:30-14:45	Introducing Facile Wet Etching Route In Fabricating Silicon Nanowires Using Sacrificial Nickel Nanoparticles L. Y. Kong S. Y. Chiam and W. K. Chim	Mr Lingyu Kong , National University of Singapore, Singapore
14:45-15:00	Nanoscale Hydrophilicity Studies of Gulf Parrotfish (Scarus persicus) Scales T-C. Tang, A. Plummer, C-Y. Lai and M. Chiesa	Ms Chia-Yun Lai, Masdar Institute, United Arab Emirates
15:00-15:15	High Young's Modulus, Flexible Multi-Walled Carbon Nanotube Fibers Produced by De-fluorination H. Nishizaka , Y. Sato, K. Hirano, Y. Sato, T. Yabune, K. Motomiya and K. Tohji,	Mr Hikaru Nishizaka , Tohoku University, Japan
15:15-15:30	Optical characteristics of aluminum-doped ceria nanoparticles N. Shehata , I. Kandas and K. Meehan	Dr Nader Shehata , Alexandria University, Egypt
15:30-15:45	Dye Doped Nanocrystalline SrAl ₂ O ₄ : Eu Phosphor: Synthesis, Characterization and Calculation of Kinetic Parameters D. S. Kshatri and A. Khare	Dr Ayush Khare , National Institute of Technology- Raipur, India
15:45-16:00	Omniphobic Transparent Coatings Using Ubiquitous Elements-No Use of Toxy Long Chain Perfluorinated Compounds-	Dr Atsushi Hozumi , National Institute of

	C. Urata, G. J. Dunderdale, M. W. England and A. Hozumi	Advanced Industrial Science and Technology (AIST), Japan
16:00-16:30	Coffee Break + Exhibition	
16:30-16:45	Correlation between Nanostructure and Mechanical Properties of Metals subjected to Severe Plastic Deformation W.Bochniak , A.Korbel and P.Ostachowski	Prof Wlodzimierz Bochniak , University of Science and Technology, Poland
16:45-17:00	Open Access Micro- and Nano-Fabrication Capabilities at the ACT Node of The Australian National Fabrication Facility F. Karouta , K. Vora, N. Shahid, L. Li, M. Lysevych and C. Jagadish	Dr Fouad Karouta , Australian National University, Australia

16 March 2015		
Session II: Nanomaterials Characterization and Tools/ Properties		
Room MAJLIS III		
Session chairs: Prof. Sachin Khapli – UAE / Dr. Antonios Kelarakis - United Kingdom		
14:00-14:15	New Tool for Enhancement of Depth Resolution in Second-ary Ion Mass Spectrometry Analysis M. Boulakroune and N. Dahraoui	Dr M'Hamed Boulakroune , University Kasdi Merbah of Ouargla, Algeria
14:15-14:30	Applications of 2- and 3-dimensional Analysis on Nanostructured Materials using advanced Characterization methods such as XPS, Auger and TOF-SIMS W. Betz , J. S. Hammond, D. F. Paul, D. Watson, P. E. Larson and R. E. Negri	Mr Wolfgang Betz , Physical Electronics, USA
14:30-14:45	Influence of dielectric properties of Hematite nanoparticles on color rendering of automotive painting M. Ben Achour , A. Chesnaud and A. Thorel	Ms Mona Ben Achour , MINES ParisTech/ CNRS, France
14:45-15:00	Nanocomposite nanowebs with self-cleaning property N. Kizildag and N. Ucar	Mrs Nuray Kizildag , Istanbul Technical University, Turkey
15:00-15:15	Effects of different configurations of curved-wall jet (CWJ) burner on the flame synthesis of titanium dioxide nanoparticles M. A. Ismail , M. S. Mansour, N. K. Memon and S.H. Chung	Mr Mohamed Ismail , King Abdullah University of Science and Technology (KAUST), Saudia Arabia
15:15-15:30	Metal Nanoparticle Stabillization via Block Copolymers V. Bütün , G. Kocak, D. Ülker, C. Tuncer and S. B. Baker	Prof Vural Butun , Eskisehir Osmangazi University, Turkey
15:30-15:45	Effect of Processing Parameters on the Morphology of Al ₂ O ₃ -TiO ₂ Nanocomposites for High Temperature Applications N. Singh , R.B. Mazumder, P. Gupta and D. Kumar	Ms Neera Singh , Indian Institute of Technology (BHU)- Varanasi, India
15:45-16:00	The investigation on the lubrication behavior of Magnesium-doped zinc oxide (Zn _{0.92} Mg _{0.08} O) nanoparticles in paraffin oil R. B. Rastogi , Kalyani, V. Jaiswal and D. Kumar	Prof Rashmi Bala Rastogi Indian Institute of Technology (BHU)- Varanasi, India
16:00-16:30	Coffee Break + Exhibition	
16:30-16:45	Investigating of the flammability, impact strength, and physical properties of wood flour/polypropylene composites A. Tavassoli and A. Samariha	Dr Afshin Tavasoli , Islamic Azad University, Iran
16:45-17:00	Hybrid DSC performance with rutile-phased TiO ₂ nanorods and nanoflowers fabricated through hydrothermal method M.K. Ahmad and K. Murakami	Dr Mohd Khairul Ahmad , Universiti Tun Hussein Onn Malaysia, Malaysia .

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Session III: Nanotech in Life Sciences and Medicine

Room MAJLIS II

Session chairs:

Dr. Matteo Chiesa / Prof. Edreese H. Alsharaeh - Saudi Arabia

09:00-9:45	Nano-mechanics of DNA in severe conditions M.R. Ejtehadi	Prof Mohammad Reza Ejtehadi , Sharif University of Technology- Tehran, Iran
09:45-10:30	Insights on the use of metaliodendrimers to fight cancer and other diseases J. Rodrigues , M. Gouveia and H. Tomás	Prof João Rodrigues , Universidade da Madeira, Portugal .
10:30-11:15	Coffee Break + Poster session I + Exhibition	
11:15-11:30	Protective and trophic properties of GDNF and its modifications for cells. G. Pavlova , N. Kust, D. Panteleev, I.Mertsalov, E Rybalkina, E. Savchenko and A. Revishchin	Dr Galina Pavlova , Institute of Gene Biology, Ltd Apto-pharm, Russian Federation
11:30-11:45	Nanomodule-Activity Relationship of G-quadruplex Based DNA Aptamers for Human Thrombin A. Kopylov , E. Zavyalova, A. Golovin and G. Pavlova	Prof Alexey Kopylov , Apto-Pharm LTD , Moscow University, Russian Federation
11:45-12:00	Synthesized and characterization of bioactive enamel coatings for dental veneering porcelain modified by bioactive glass P. Hemanth Kumar , Abhinav Srivastava, Vijay Kumar, V Divya Bhargavi, Khagesh Kumar Tanwar, Pradeep Kumar and Vinay Kumar Singh	Mr Pattem Hemanth Kumar Indian Institute of Technology (BHU)- Varanasi, India
12:00-12:15	Effect of Polysacccharide Chemistry on the Solution Concentration of Nanoparticle Complexes of Polysaccharides and Antiviral Drugs S. Mazumder	Dr Sonal Mazumder , Birla Institute of Technology and Science, India
12:30-14:00	Lunch Break + Poster session I+ Exhibition	

Room MAJLIS II

Session chairs:

Prof. Taleb Ibrahim- UAE/ Prof. João Rodrigues - Portugal.

14:00-14:45	MWI Synthesis and Characterization of Highly Conductive R-(GO-(PS-PMMA))/AgNPs Nano composites and its Antibacterial Activity against E.Coli E.H. Alsharaeh	Prof Edreese H. Alsharaeh , Alfaisal University Riyadh, Saudi Arabia
14:45-15:00	The Small Wonder: Nanoparticles-Based Smart Materials for Therapy & Imaging A. Trabolsi and F. Benyettou	Prof Ali Trabolsi , New York University Abu Dhabi, United Arab Emirates
15:00-15:15	Fluorescent Carbogenic Nanoparticles M. Krysmann	Dr Marta Krysmann , University of Central Lancashire, United Kingdom
15:15-15:30	Bismuth Sulphide Nanoparticles coated with PVP as contrast agents for X-ray Computed tomography imaging (CT) and effects of different tube potentials. M. Algethami , A. Blencowe,, A. Kelong, L.Lu and M. Geso	Ms Merfat Algethami , School of Medical Science, RMIT University, Australia
15:30-15:45	Sonolytic Synthesis of Bimetallic Magnetic Nanomaterials – Effects Solution Chemistry on Reaction Kinetics G.L. Moore, D. Kumar and K.L. Roberts	Dr Kenneth L. Roberts , King Faisal University, Saudi Arabia
15:45-16:00	Effect of Solvents on the Dispersion of Graphene Nanoplatelets in Nanohydroxyapatite for Load Bearing Body Implants MM. Feven , M. Khalid, ME. Hoque and CT. Ratnam	Ms Feven Michael , University of Nottingham Malaysia Campus, Malaysia
16:00-16:30	Coffee Break + Poster session I + Exhibition	
16:30-16:45	Antifungal volatile compounds encapsulated in nanoparticles F. Gonzalez-Nilo , R. Polanco, L. Velasquez, H. Mendoza and R. Campos	Dr Fernando Gonzalez-Nilo , Universidad Andres Bello, Chile
16:45-17:00	Synthesis and characterization of hydroxyapatite based nanocomposites for structural applications A. Mishra, M.Gond , S.B.Kumar and D.Roy	Mr Manas Gond , National Institute of Foundry and

		Forge Technology.(NIFFT-Ranchi), India .
17:00-17:15	Developed and characterization of polymeric nanoparticles based on poly(3-hydroxybutyric acid-co-hydroxyvaleric acid) (PHBV) multifunctionalized with SPIONs, antineoplastic, antibiotics and their applications P. Solar, F. Gonzalez-Nilo, A. Aravena, C. Vilos, F. Morales, N. Herrera and L. Velasquez	Dr Luis Velasquez , Universidad Andres Bello, Chile
17:15-17:30	Novel Application of Well-Ordered Mesoporous Silica Nanoparticles as Potent Adsorbent of Phenobarbital F. Farjadian , P. Ahmadpour and S. Mohammadi Samani	Dr Fatemeh Farjadian , Shiraz University of Medical Science, Iran .

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Session IV: Nanotech for Energy and Environment

Room MAJLIS III

Session chairs:

Prof. Muhammad Hussain - Saudi Arabia

09:00-9:45	Carbon Nanostructures for Electricity Storage Applications B. Wei	Prof Bingqing Wei , University of Delaware, USA
09:45-10:00	Preparation of ZnO doped with CdS nanoparticles for clean, green and sustained power source as solar cell materials B. Rakesh , N. Bhagat and B. Pandey	Mr Balaji Rakesh , Symbiosis Insitute of technology-Pune, India .
10:00-10:15	The Design and Investigation of a Novel Nano Dye Sensitized Solar Cell (DSSC) with Utilizing Coating Paints on Porous Surface to Promote Energy Efficiency B. Hormozi , M. Khodayai Mafi and H. Shafie	Mr Behnoud Hormozi , Islamic Azad University-Arak, Iran
10:15-10:30	Preparation and Fabrication of Quantum Dot-Sensitized Solar Cells (QDSSC) with CdS Quantum Dots a prepared by an ultrasonic-assisted chemical bath deposition method K.M. Sahan , B.H. Jawad and M.R.M. Ali	Mr Kassim M. Sahan , Renewable energy directorate, Ministry of science and technology, Iraq
10:30-11:15	Coffee Break + Poster session I + Exhibition	
11:15-11:30	Carbon-Nano-Tube (CNT) from Carbon Rich Fly Ash: its production and expected futuristic trend A.A Alghamdi and N. Salah.	Prof Attieh A Alghamdi , King Abdulaziz University, Jeddah, Saudi Arabia
11:30-11:45	Utilization of Waste Cooking Oils for Biodiesel Production using Nanocatalysts H. El Shimi , N. Attia, S. El Sheltawy and G. El Diwani	Mr Hassan El Shimi , Cairo University, Egypt
11:45-12:00	Photocatalytic ozonation of bromide containing waste water: related problems and kinetic based strategy evaluation F.Parrino ,, G.Camera-Roda, V.Loddo, V. Augugliaro and L. Palmisano1	Dr Francesco Parrino , University of Palermo, Italy
12:00-12:15	Fabrication and characterization of ZnO nanoparticles by thermal decomposition of Zinc picolinate and Zinc citrate dihydrate I. Kontopoulou, A. Angelopoulou, S. Baskoutas and N. Bouropoulos	Prof Nikolaos Bouropoulos , University of Patras, Greece
12:30-14:00	Lunch Break + Poster session I + Exhibition	

Session V: Nano-Electronics

Room MAJLIS III

Session chairs:

Prof. Khaled Saoud, Qatar/ Prof. Bingqing Wei - USA

14:00-14:45	Wearable Interactive Electronics for Smart Living and Sustainable Future M. Hussain , J. Rojas, G. Torres Sevilla, A. Hussain and M. Ghoneim	Prof Muhammad Hussain , King Abdullah University of Science and Technology, Saudia Arabia
14:45-15:00	Design of plasmonic structures using capillary force assembly J. Cordeiro , O. Lecarme, D. Peyrade, T. Jägeler-Hoheisel, A. Cuche, C. Girard, E. Dujardin and, A. Arbouet.	Dr Julien Cordeiro , Smart Force Technologies LTM- CNRS, France
15:00-15:15	Torsional Resonators Under Mixed-frequency Excitation for Improved Bandwidth	Mr Saad Ilyas , King Abdullah University of

	S. Ilyas , A. Ramini and M.I Younis	Science and Technology, Saudia Arabia
15:15-15:30	Higher Order Modes Excitation of Micro Clamped-Clamped Beams N. Jaber , A. Ramini, A. Carreno and M.I Younis	Mr Nizar Jaber , King Abdullah University of Science and Technology, Saudia Arabia
15:30-15:45	Some Ceria Based Solid Electrolytes for IT-SOFCs O. Parkash , N. Jaiswal, S. Upadhyay and D. Kumar	Prof. Om Parkash , Indian Institute of Technology (BHU)- Varanasi, India
15:45-16:00	Preparing transperence conductive glass by using APCVD system N. Ali	Ms Nagam Ali , University of Baghdad, Iraq
16:00-16:30	Coffee Break + Poster session I + Exhibition	
16:30-16:45	Wear Behaviour of Nano Si C- C Composite in lubrication N. El Mehad	Prof. Noura Elmehbad , Najran University, Saudi Arabia
16:45-17:00	Oxide Ion Conduction in La ²⁺ and Sr ²⁺ Co-Doped Ceria/(Li-Na) ₂ CO ₃ Multifunctional Nanocomposite electrolyte for LT-SOFCs N. Jaiswal , S. Upadhyay, D. Kumar and O. Parkash	Ms Nandini Jaiswal , Indian Institute of Technology (BHU)- Varanasi, India

18 March 2015 :
Poster session II / Awards Ceremony

Room MAJLIS I

Session Chairs:
Prof. Taleb Ibrahim - UAE / Prof. Khaled Saoud – Qatar
Prof Muhammad Hussain - Saudi Arabia

10:00-13:00	Closing Ceremony Cocktail + Poster session II + Exhibition	
11:00-13:00	Closing and Awards Ceremony: Poster and Oral Presentations awards	

Posters Session I
Advanced NanoMaterials
Nanomaterials Fabrication, Characterization and Tools
Nanotech in Life Sciences and Medicine

N.	Title	Author/Affiliation/Country
1	Synthesis of transition metal oxide core-shell and composite nanoparticles and their magnetic properties A. Ullrich , S. Hohenberger, A. Oezden and S. Horn	Dr Aladin Ullrich , Universität Augsburg, Germany
2	Novel Strategy to Produce Hollow Half-Nanosphere Arrays Y. Gao , Y. Hou and P. M. Beajudge	Mr Yangqin Gao , King Abdullah University of Science and Technology (KAUST), Saudi Arabia
3	Gladiator: Graphene Layers: Production, Characterization and Integration – Future of Graphene Production J. Lama , I. Gil, A. González and G. Roman	Mr Jesus Lama , Sgenia, Spain
4	Synthesis and characterization of TiO ₂ based inorganicorganic hybrid photocatalysts for enhancing the selective formation of 4-methoxybenzaldehyde from 4-methoxybenzyl alcohol A. Abd-Elal , F. Parrino, M. Pagliaro, R. Ciriminna, V. Loddo and L. Palmisano	Dr Ali Abd-Elal , Egyptian Petroleum Research Institute, Egypt
5	Ion irradiation induced porosity in Ge and Si _{1-x} Gex alloys H. Alkhaldi , F. Kremer, P. Kluth, and M.C. Ridgway	Mrs Huda Alkhaldi , The Australian National University-Canberra, Australia.
6	Nanostructured zirconia/graphene oxide hybrids: physico-chemical studies S. N. Bashel, M. Mokhtar , E. Alsharaeh, T.T. Ali, H.A. Mahmoud and K. Narasimharao	Prof Mohamed Mostafa , King Abdulaziz University, Saudi Arabia
7	Biocompatible carbon nanotube/polypeptide hybrids as the platform of biomedical applications and toxicity assessment J-H. Ciou, K-C. Yang, Y-S. Liu, P-W. Chen, S-S. Chen, C. G. Salzmann, K-C. Lee and E-C. Cho	Professor Er-Chieh Cho , Taipei Medical University, Taiwan/ Professor Kuen-Chan Lee , Kaohsiung Medical University, Taiwan
8	Gold Nanoparticle Loaded Core-CrossLinked MPEG-b-PGMA Micelles G. Kocak and V. Bütün	Mr Gökhan KOÇAK , Eskisehir Osmangazi University, Turkey
9	Synergistic effect of Doxorubicin-loaded core-shell silver/PEG nanoparticles on breast cancer cells N.M. El-Baz , L. Ziko, R. Siam and W. Mamdouh	Dr Nancy Elbaz , The American University in Cairo, Egypt
10	Structural parameters of nanocrystalline calcium phosphate using CTAB as a cationic template M. M. Méndez-González and G. Méndez G	Dr Magdalena Mendez , National Polytechnic Institute- Mexico City, Mexico.
11	Estimation of Tramadol in Earwax and Urine: A comparative Study A.M. Massadeh , N.H. Ahmed and M. Fayyad	Prof Adnan Massadeh , Jordan University of Science and Technology, Jordan.
12	Bismuth Sulphide Nanoparticles coated with PVP and DSPE-PEG as contrast agents for X-ray Computed tomography imaging (CT) M. Algethami , A. Blencowe, A. Kelong, L. Lu and M. Geso	Ms Merfat Algethami , School of Medical Science, RMIT University, Australia
13	Microencapsulation of Phenobarbital by EthylCellulose matrix S. Bouameur and S. Chirani	Ms Sarah Bouameur , University Djillali Liabes of Sidi Bel-Abbes, Algeria
14	Bioencapsulation of aminocetophen (paracetamol) in ethylcellulose matrix and study of its drug delivery from microparticles S. Chirani , S. Addadi, S. Benmahammed and S. Bouameur	Dr Chirani Soumia , University Djillali Liabes of Sidi Bel-Abbes, Algeria
15	Cytotoxicity reduction as a main challenge on gold nanorods synthesis using seedless silver-assisted method J. Valkovičová , V. Bernard, J. Drbohlavová	Jirina Valkovicova , Masaryk University, Czech Republic

Posters Session II

Nanotech for Energy and Environment Nanoelectronics

N.	Title	Author/Affiliation/Country
1	Microfabricated Pseudocapacitors Using Ni(OH) ₂ Electrodes Exhibit Remarkable Volumetric Capacitance and Energy Density Narendra Kurra, Nuha A. Alhebshi , and H. N. Alshareef	Mr Nuha Alhebshi , King Abdullah University of Science and Technology (KAUST), Saudi Arabia
2	Electrical Contacts to Organic Molecules (DNA) using Nano transfer printing technique S. Abdalla , F. M. Al-Marzouki, and A.A. Al-Ghamdi	Prof Soliman Abdalla , King Abdulaziz University Jeddah, Saudi Arabia
3	Charge-Transport Properties across Self-Assmbed Monolayers Using AgTS/SAM//Ga ₂ O ₃ /EGaIn Junctions M. H. Al-Sayah , C.M. Bowers, M. Baghbanzadeh and G.M. Whitesides	Prof Mohammad H. Al-Sayah American University of Sharjah, United Arab Emirates
4	First principles calculations of structural and optoelectronic properties of cubic perovskite CsBeF ₃ M. Harmel and Khachai	Dr Meriem HARMEL , University of Sidi Bel-Abbes, Algeria
5	Modeling of the structure GaInAsN/GaAs for solar Cells applications A.Aissat , B. Alshehri and J.P. Vilcot	Prof Abdelkader Aissat , University of Blida, Algeria
6	Nanoholes: high speed surface nanomachining for optical performance improvement A. González, I. Gil , G. Roman, J. Lama	Ms Isabel Gil , Sgenia, Spain
7	Modification of nanoclay and its application for the removal of Cadmium from water samples Sh. Elhami and M. Bakhtiari	Dr Shahla Elhami , Islamic Azad University, Khouzesan, Iran
8	Pollution in the channel of oued righ and Dieback Palm S. Benguergoura Laradj and B. Remini	Dr Benguergoura Laradj Samia , University Saad Dahlab Blida, Algeria
9	Modeling of adsorption of two organic pollutants on activated carbon pre-pared from synthetic waste (tires) and commercial coal: Comparative Study Z. Chennouf-Abdellatif , N. Bouchenafa-Saib and F.Messaoudi	Mrs Chennouf-Abdellatif Zohra , University of Blida, Algeria
10	Mesoporous Materials Ga doped SBA-15 for Use as Support in Friedel Crafts Acylation: Activity and Stability F.Z. EL Berrichi , L. Cherif and C.Pham.Huu	Prof Fatima Zohra El Berrichi , University of 8Mai1945- Guelma, Algeria
11	Equilibrium and Kinetic adsorption atudy of anionic dye by activated clays S. Zen and F.Z. EL Berrichi	Prof Fatima Zohra El Berrichi , University of 8Mai1945- Guelma, Algeria
12	Preparation, Characterization and application of gold nanoparticles stabilized in Acid-activated montmorillonite F. Ammari , M. Chenouf and S. Sakrane	Dr Fatima Ammari , Ferhat Abbas Setif1 University, Algeria
13	Efficiency improvement of the structure InAsN/GaN for solar Cells applications M. El Bey , A.Aissat, R. Bestam and J.P. Vilcot	Mr Moussa El Bey , University of Blida, Algeria

Oral Presentations

Emerging Nanotechnologies: Status Quo

A. Kelarakis

Centre for Materials Science, School of Forensic and Investigative Sciences, University of Central Lancashire, Preston PR12HE, UK

Abstract: Emerging nanotechnologies promise to deliver highly adaptive, multi-functional materials with great potential to revolutionize every aspect of human activity. While nature has set the bar too high by optimizing a large number of self-sustained, self-evolved nanostructures all over the planet, it seems that the scientific and engineering community is on track to accomplish remarkable targets towards that direction. First things first; our efforts to gain control over the nano-dimensions should not ignore or overrule issues related to ethics, bioethics and the sustainability of the ecosystem.

Polymer nanocomposites are ideal systems to showcase the distinct advantages in using nanoparticles, given that they oftentimes impart simultaneous enhancements in both mechanical strength and toughness, behavior inaccessible for conventional composites. In addition, well-dispersed polymer nanocomposites exhibit superior rheological and barrier properties, electrical and ionic conductivity etc. But, here is the catch; in the absence of efficient matrix-filler interactions, the nanoparticle dispersion is poor and the macroscopic performance of the hybrids might well be inferior compared to the corresponding neat polymers. As a result, covalent or non-covalent functionalization of the nanoparticles is usually necessary to promote dispersion in polymeric matrices (Kelarakis et al. 2006).

Advanced coating strategies afford topographical surface characteristics resolved in the nanoscale stemming from nanoparticle deposition or, alternatively, from phase separation effects. Those coatings impart significant performance improvements in terms of fire retardancy, scratch resistance, antireflection, chemical stability against oxidation and decomposition, stimuli responsive wetting behavior, improved color retention and self-cleaning. For example, deposition of positively charged silica nanoparticles to negatively charged plasma treated polypropylene reduces the water contact angle from 71° to virtually zero (Fang et al. 2010).

Hierarchical organization and biomimetic approaches are central to nanotechnology. A typical example is the architectural design of the bone that shows seven distinct levels of hierarchy starting from an amino acid that form peptides, tropocollagen, collagen fibrils that are further self-assembled to larger structures. This design gives rise to substantial mechanical reinforcement compared to the strength of its building components.

In analogy, there are also great surprises when we go down the structural hierarchy; a highly flexible sin-

gle layer of graphene is derived by mechanical exfoliation of the super-brittle graphite. The graphene monolayer is not photoactive, but its tiny pieces exhibit characteristic, excitation wavelength dependent, photoluminescence properties. Those remarkable properties carry great promise for applications related to advanced therapeutics and diagnostics, bioimaging, photocatalysts and multicolor printing (Kelarakis, 2014).

In another example, bulk gold behaves as an inert metal, but gold nanoparticles demonstrate unexpected catalytic properties. At the same time, the optical properties of colloidal gold dispersions critically depend upon the size of the suspended nanoparticles, an effect that is systematically explored for the development of advanced sensors.

Despite great challenges, nanotechnology is a rapidly emerging field of continuous innovation that has already realized cutting-edge applications in electronics, medicine, energy production, etc. It should be emphasized that nanotechnology is not a mere adaptation of conventional engineering at a lower scale, in the sense that certain materials behave in a fundamentally different manner when they approach their nanoscale limit.

Keywords: nanocomposites, nanotechnology, coating, graphene, hierarchical, biomimetics.

References:

Kelarakis, A., Yoon, K., Somani, R.H., Sics, I., Chen, X., Hsiao, B. S., Chu, B (2006), Relationship between structure and dynamic mechanical properties of a carbon nanofiller reinforced elastomeric composite, *Polymer*, 47,6797-6807.

Fang, J., Kelarakis, A., Estevez, L., Wang, Y., Rodriguez, R., Giannelis, E.P. (2010) Superhydrophilic and solvent resistant coatings on polypropylene fabrics by a simple deposition process, *Journal of Materials Chemistry*, 20,1651-1653.

Kelarakis, A. (2014) From highly graphitic to amorphous carbon dots: a critical review, *MRS Energy and Sustainability*, 1.

Synthesis and Characterization of Alkaline Earth Nanomaterials for the Preservation of Cultural Heritage Artifacts

Khaled m. Saoud

Liberal Arts and Sciences Program, Virginia Commonwealth University in Qatar, Doha, Qatar,
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Abstract:

Preserving cultural artifacts is crucial to understand the past of a nation as it provides us a unique window into the history and culture of that nation. The preservation and restoration of cultural heritage objects which are in danger of being lost from a variety of factors including environmental degradation adds to the overall value of the global human culture and keeps it alive for future generations.

In this paper, we present the microwave-assisted synthesis and characterization of alkaline earth nanomaterials for the preservation of cultural heritage. Calcium, barium, and Magnesium hydroxide nanomaterials suspended in aqueous as well as alcoholic medium were applied on different samples to check their effectiveness toward deacidification and enhancing the mechanical strength of cultural heritage artifacts. The effect of treatment was measured using pH value, alkaline reserve test and mechanical strength of the paper. The alkaline reserve test results indicate improvement in the alkaline buffer with significant reduction in acidity of the papers and improvement in pH value of the surfaces. Ethanol was found as best solvent on the basis of suspension of nanoparticles, pH value and ease of application through spray gun. Accelerated ageing test revealed that the reinforcement effect of these nanomaterials persisted throughout the ageing. The nanomaterials of calcium hydroxide, magnesium hydroxide and barium hydroxide, were successfully synthesized using novel microwave synthesis technique. The effectiveness of these materials toward conservation of cultural heritage artifacts, specifically paper samples from old books and newspapers was successfully studied. State of the art characterization techniques like XRD, SEM, HR-TEM were used to elucidate the composition and structure of Ba(OH)₂, Ca(OH)₂, and Mg(OH)₂ nanomaterials. The BET Surface Area and nitrogen adsorption/desorption measurements of Ba(OH)₂, BaMg Alloy, and Mg(OH)₂ nanoparticles showed that the surface area of Ba(OH)₂ is 4.558 m²/g, BaMg Alloy is 7.992 m²/g, and Mg(OH)₂ sample is 80.27 m²/g. HR-TEM analysis revealed the morphology of Mg(OH)₂ to be composed of nano sheets with a unique packing structure that gives a highly porous nano structure to the material. Our results indicate significant improvement in the paper strength in all samples. In fact, the value of fracture stress nearly doubled. We attributed this results to the presence of acidic con-

tent in the old paper due to aging where the applied treatments work against the acidic contents, neutralized it and also provided the paper with a reserve for future aging.

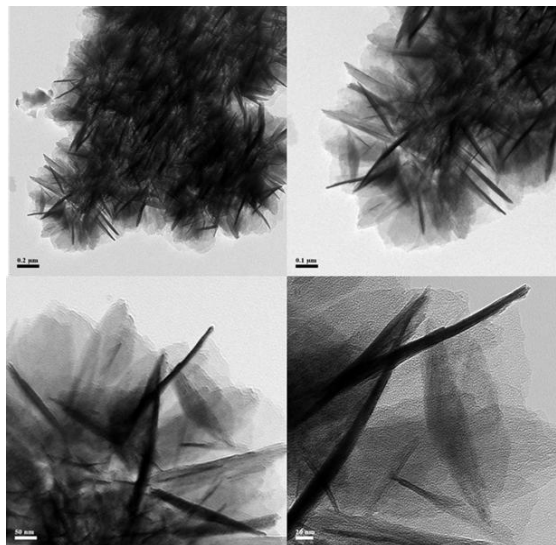


Figure 1: High Resolution Transmission electron microscopy (HRTEM) micrograph of Mg(OH)₂ Nano Sheets at different magnifications.

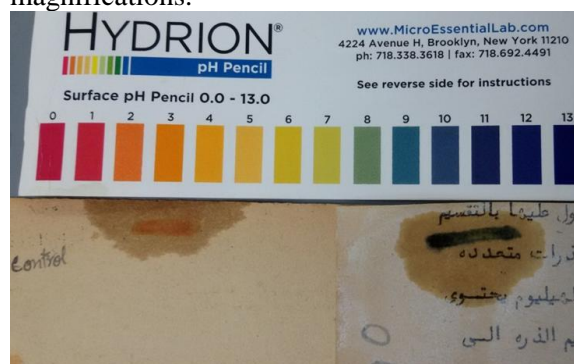


Figure 2: pH measurement of Reference old paper and old paper treated with Mg(OH)₂ nano-particles.

The presence of excess nanoparticle in the paper as alkaline reserve seems to fill the interstitial spaces or the micro pores of the paper and provided it mechanical strength.

Finally, we concluded that Mg(OH)₂ nanoparticles stands out to be most promising among all. Mg(OH)₂ is composed of nano sheets with a size smaller than 5 nm and a unique packing structure that gives a highly

porous nano structure to the material with a high surface area. Mg(OH)₂ when applied on old paper sample, Mg(OH)₂ gave positive values for Alkaline reserve equivalent to 372 mmol/kg, which is close to the value required for a life expectancy of at least 500 years..

Keywords: Keywords: Cultural heritage, Nanomaterials, paper deacidification, alkaline reserve, Calcium hydroxide, Barium hydroxide., Magnesium Hydroxide Nanosheets.

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Supercritical Fluid Technology for Fabrication of Nanomaterials

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Abstract: Supercritical fluids provide an attractive medium for the synthesis of nanomaterials due to their pressure-tunable thermodynamic and transport properties that are intermediate between those of gaseous and liquid states. Supercritical carbon dioxide (sc-CO₂) is widely used due to its non-toxic nature, mild-operating conditions ($T_c = 304.25$ K and $P_c = 7.39$ MPa), relative abundance, and potential to reduce environmental footprint. It has found widespread applications in the food and pharmaceutical industries where it is used for extraction, chemical transformation, and micronization of active ingredients. Several processes have been developed for the fabrication of nanomaterials using sc-CO₂ as a medium, e.g. Rapid Expansion of Supercritical Solutions (RESS), Supercritical Anti-solvent precipitation (SAS), and Supercritical Assisted Atomization (SAA).

We report the application of a modified RESS process to create nanoparticles of organic compounds with appreciable solubility in sc-CO₂ (Khapli *et al.*; 2014, 2015, Jagannathan *et al.*; 2006). Fine particles with diameters ranging from 10-100 nm can be synthesized from corresponding solutions in supercritical CO₂. Nanoparticles can be efficiently recovered from expanded gaseous stream by formation of dry ice in a liquid nitrogen-cooled trap, and subsequently dispersed in organic solvents (acetone, ethanol, and n-heptane) creating surfactant-free dispersions. We demonstrate the utility of this technique for producing nanoparticles of polymeric (amorphous fluoropolymer, Teflon-AF1600) as well as molecular (ibuprofen, and naproxane) compounds. Interestingly, when nanoparticles of amorphous fluoropolymer, Teflon-AF1600 are dispersed in water, they self-assemble at the air-water interface forming mechanically robust, superhydrophobic films (Figure 1a).

For processing of water soluble compounds, we utilize a sc-CO₂ based atomization technique. In this technique, dense aerosols with droplet size less than 3 μm are created by atomization of aqueous solutions equilibrated with sc-CO₂. Along with the small size of droplets produced, this method offers the added benefit that aerosol droplets are saturated with carbon dioxide. We utilize this technique for the fabrication of porous films deposited by continuous evaporation of aerosol microdroplets on superheated substrates at atmospheric pressure. Our method does not use any sacrificial templates to create 3-dimensional scaffolds of ceramics and is applicable to a wide variety of materials such as CaCO₃, ZnO, CuO, Co₃O₄, Co-doped ZnO, and Ag₂O (Khapli *et al.*; 2014). A variety of porous scaffolds with 1-3 micron sized pores can be generated by tuning the process conditions.

Subsequent sintering of the scaffolds is shown to generate nano-sized pores in the walls of the porous scaffold creating a dual hierarchy of pore sizes (~50 nm & 1-3 μm). We propose a mechanism for the formation of scaffolds based on the coffee-ring effect during the evaporation of microdroplets. Ostwald-ripening of CaCO₃ scaffolds prepared without sintering yields scaffold structures consisting of 2-dimensional crystals of CaCO₃ that are one unit cell thick (Figure 1b).

Keywords: supercritical fluids, supercritical carbon dioxide, sc-CO₂, Rapid Expansion of Supercritical Solutions, RESS, amorphous Teflon, Teflon-AF, nanoparticles, nanowires, hierarchically porous materials, nanoindentation, CaCO₃.

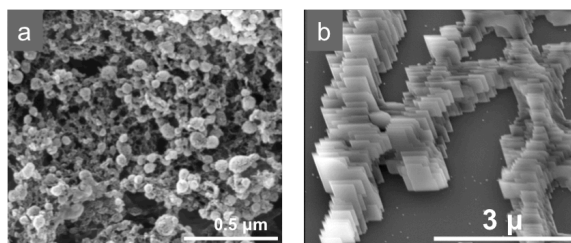


Figure 1: SEM micrographs of (a) Superhydrophobic films of Teflon-AF nanoparticles prepared by modified RESS process and (b) porous films consisting of unit-cell thick crystals of CaCO₃ prepared by sc-CO₂ based atomization technique.

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Structural characterization of materials at the nanoscale: the XRD issue

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Abstract:

Regarding the structural characterization of materials, few techniques can be safely and routinely used, and changes in the field are slow: single-crystal diffraction is still the technique of choice for the relevant cases, powder XRD and electron microscopy (TEM) being heavily used for most solid phases, often in combination.

Classic XRD however has limitations: when the material is made of very small crystallites, eventually affected by a strong static disorder, only broad haloes can be obtained and the structural study then only relies on TEM, a local probe which also has biases.

Another statistic probe can however be routinely operated in laboratory, close to XRD but under specific conditions: shorter wavelength, extended angular range and Fourier Transform. This version of XRD is better known as Wide-Angle X-ray Scattering (WAXS) or Pair Distribution Function (PDF) It provides similar structural information in the real space, often straightforward and better suited for the analysis of nanoparticles. The technique has been successfully applied to the study of many mono- and bi-metallic systems of interest for their magnetic or catalytic properties. Different materials recently studied will be presented to illustrate the potential of this less used technique. In the field of nanomaterials, the PDF approach demonstrates a very high sensitivity to ordering, which proved useful to understand and improve difficult syntheses, and is also a simple way to study sensitive samples, in combination with TEM.

Keywords:

Pair Distribution Function, Wide-angle X-ray Scattering, metallic nanoparticles, catalysis.

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Diameter-controlled synthesis of SWNTs for high performance devices

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Abstract: We present a robust and versatile approach for the reproducible and controllable growth of single wall carbon nanotubes (SWNTs) through a self-assembled monolayer (SAM) technique coupled with an atomic hydrogen (Hat) pretreatment to control the catalytic metallic nanoparticles size and density (Bouanis et al.; 2014). The nanoparticles are obtained from a self-assembled monolayer of metal complexes or salts on a SiO₂ substrate using a two-step strategy. The oxide is first functionalized by silanisation with a coordinating ligand leading to the formation of an anchoring SAM on the substrate. Then, metallic complexes such as ruthenium porphyrin (RuTPP) or metallic salts (FeCl₃, RuCl₃) are assembled by coordination bonds on the preformed organic SAM. Pyrolysis under radical hydrogen atmosphere of the as-prepared SAM yields metallic nanoparticles whose size and density are controlled and tuned. Using the as-formed nanoparticles as catalysts, SWNTs are grown by double hot filament assisted chemical vapor deposition (d-HFCVD). They exhibit a remarkably good crystalline quality, with a diameter (and type) strongly dependent on the nature of the initial catalyst precursor and its preparation. Field effect transistors (FETs) with excellent characteristics were obtained using such in-place grown SWNTs. The electronic properties of the SWNTs can be tuned: the transistors obtained from Ru(TPP) and FeCl₃ exhibit I_{ON}/I_{OFF} current ratio up to $\sim 10^9$, indicative of the direct growth of a high proportion of semiconducting nanotubes over than 98% (Wu et al.; 2012). Such elevated values have been reported essentially for CNT-FETs devices based on individual semiconducting SWNTs (Seidel et al.; 2004). By contrast, devices obtained from the RuCl₃ salt display I_{ON}/I_{OFF} current ratio well below 10^2 , indicating the direct growth of SWNTs highly enriched in metallic specimens.

Keywords: self-assembled monolayer (SAM), hydrogen (Hat) pretreatment, nanoclusters, diameter control, single walled carbon nanotubes (SWNTs) and Field effect transistors (FETs).

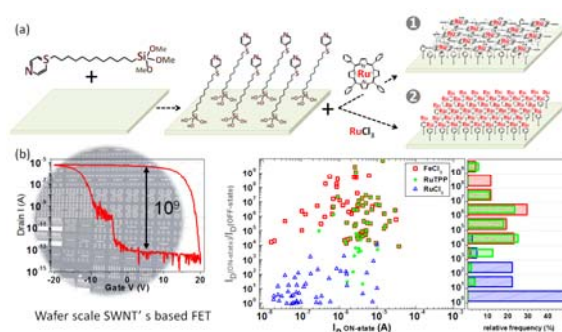


Figure 1: SAM-based strategy for controlling the diameter of metallic nanoparticles to be used as catalysts for d-HFCVD growth of SWNTs: (a) Substrate functionalization by a first “anchoring” SAM of a pyridine organic compound and the overlayer formed by a second SAM of a metallic complex, either (1) porphyrin ruthenium (II) carbonyl (Ru(TPP)) or (2) ruthenium (III) chloride (RuCl₃). (b) Transfer ($I_{ON}/I_{OFF} - I_{ON}$) characteristics at various I_{ON} values from 10^{-3} to 10^{-8} (A).

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Wear able Interactive Electronics for Smart Living and Sustainable Future

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Abstract: We report on heterogeneous electronic materials and high-performance complementary metal oxide semiconductor (CMOS) based tunable shape-size-conformity wearable interactive electronics and systems for smart living (computation-communication-infotainment) through internet of everything and a sustainable future (healthcare-water-food-environment-security). For scientific exploration, we make collective use of the materials, processes and device architecture leveraging multidisciplinary tracks of material science, bioengineering, mechanical, environmental engineering and computer science. As engineering tool, we use CMOS technology extensively due to its industrial relevance, maturity and reliability for rapid tech transfer.

Thin film based inorganic electronics dominate nearly all areas of electronics: logic, memory, display, power devices, medical electronics, micro/nanoelectromechanical systems (M/NEMS), energy devices, analog devices and in automobile electronics. Examples include but not limited to silicon, silicon germanium, gallium nitride, indium phosphide, silicon carbide, etc. Ninety percent of the digital electronics are made with bulk mono-crystalline silicon (100). Although these electronics show extraordinary performance (processing speed), power savings (energy efficiency), multi-functionality (due to ultra-large-scale-integration density) and cost-savings (due to batch processing using CMOS technology), they are rigid and brittle. Therefore, our approach is to transform such electronics into flexible-stretchable-reconfigurable one while retaining their inherent advantages and constantly integrate them with upcoming active materials (0D, 1D, 2D, organic) in an opportunistic way to open up new horizons for electronics and information technology. In the past, transfer printing, spalling, back grinding have been used to make ultra-thin inorganic electronics based flexible and stretchable electronics but often they lack in competitive charge transport (due to usage of unconventional silicon (111) with many defect dislocations), expense (expensive silicon-on-insulator or ultra-thin silicon substrate, low throughput epitaxy, expensive high energy ion implantation, device damage during back grinding or spalling, complete wastage of wafer, etc.), and compromise in integration density (specially through transfer printing of small devices). To address them, we have developed CMOS processes based new technologies and applications opening up multiple fronts in science and engineering. One key question is: when the

ICs are so tiny why do we need to make them flexible? In reality the most powerful ICs like microprocessors for computers or cell phones are not small ($> 1 \text{ cm}^2$). Specially for implantation on soft tissue or organs and on asymmetric curvilinear surface we need multi-functional high-performance ICs like them and thus flexing them is critical. In that regard, in my keynote speech I will detail two of our major efforts:

1. Layered Ultra-thin Inorganic Film Based Flexible Electronics [1, 2]
2. Stretchable Inorganic Thin Film Fabric [3, 4]

As examples, I will use state-of-the-art sub-20 nm FinFET CMOS with advanced high- κ /metal gate stack and smart thermal patch to demonstrate the effectiveness of the developed processes.

Keywords: ultra-thin electronics, flexible electronics, stretchable electronics, FinFET, advanced healthcare.

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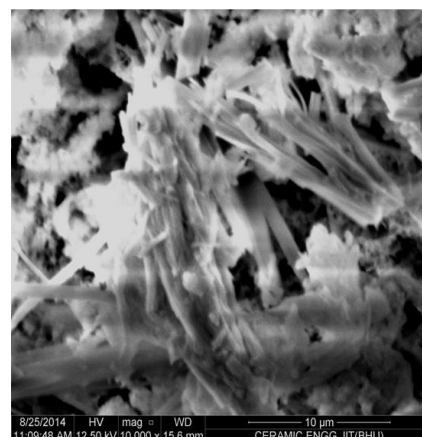
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Synthesis and characterizations of GDC nanowires by wet chemical route for LT-SOFC

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Abstract: Nanocomposite electrolyte with high ionic conductivity and low operating temperature for solid oxide fuel cell has been prepared by mixing Gadolinium doped Ceria (GDC- $\text{Ce}_{0.80}\text{Gd}_{0.20}\text{O}_{1.90}$), nanowires obtained by wet chemical route and binary mixture of $(\text{Li-Na})_2\text{CO}_3$ in wt. ratio of 65:35. Single phase formation has been found in the sample i.e. carbonates present as amorphous phase. Carbonates act as grain growth inhibitor and increase the stability of nanowires due to low sintering temperature of 700°C . Microstructure shows that GDC nanowires having high aspect ratio in the matrix are present. It helps in enhancing the conductivity due to large grain-boundary/interface that facilitates super-ionic conduction. There may be contribution to conductivity from other ions as reported in the literature. In presence of H_2/O_2 atmosphere composite shows multi-ion conduction (O^{2-} , H^+ and CO_3^{2-}) above the softening point of carbonates. Due to multi ion conduction it has applications in several fields such as solid oxide fuel cells, solid oxide electrolysis cell, synthesis of NH_3 , direct carbon fuel cell and CO_2 separation etc.

Keywords: Wet chemical synthesis; Nanowires; Composite electrolyte; Electrical conductivity; LT-SOFC.



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Figure 1: SEM image of the composite-GDC/Composite nanowires.

Synthesis and characterization of controlled ZnO nanorods lengths

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Abstract: Well-crystallized ZnO nanorods of controlled lengths were synthesized by chemical route method without surface modification. The morphology and structure of the nanorods were characterized by transmission electron microscopy, X-ray diffraction, and Electrostatic force microscopy (EFM). It was observed that the ZnO nanorods are hexagonal-shaped with diameters in the range of 12-14 nm and length of 100-300 nm based on synthesis of nanorods. Photoluminescence (PL) and Raman spectroscopy measurements have been performed at room temperature. The PL results showed that the intensity of ultraviolet (UV) and visible emissions bands depend on the length reduction. The observed intensity variation of ultraviolet and green emissions due to the effect of ZnO nanorods length may have the possibility to use ZnO nanorods in various colored LEDs or photovoltaic applications.

Keywords: ZnO nanorods, Electrostatic force microscopy (EFM), UV-Vis spectroscopy, photoluminescence spectroscopy .

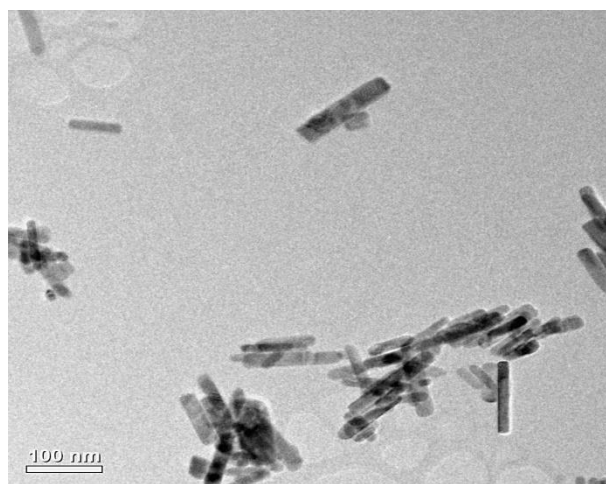


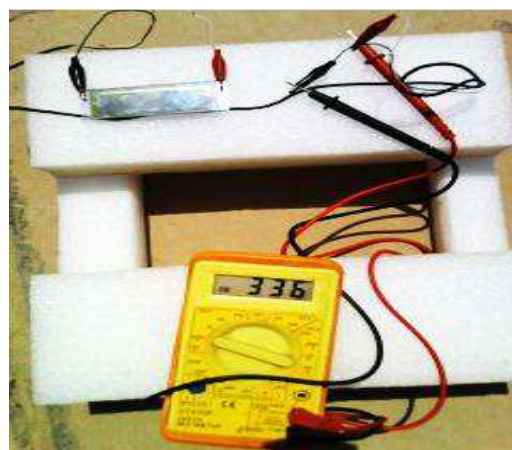
Figure 1: High-resolution TEM image of ZnO nanorods obtained by chemical route method.

Preparation and Fabrication of Quantum Dot-Sensitized Solar Cells (QDSSC) with CdS Quantum Dots a prepared by an ultrasonic-assisted chemical bath deposition method

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Abstract: Quantum dot sensitized solar cells (QDSSCs) are a promising low cost option to existing PV technologies such as crystalline silicon (silicon) and thin inorganic films. A QDSSC make use of Quantum Dots (QDs) as light absorbing material (Lai *et al.*; 2014, Mohammad; 2013, Jun *et al.*; 2013, Daniel *et al.*; 2012). In this study, we have been manufacturing one of the important hybrid solar cells that operate on quantum dots light-sensitive instead of organic dyes sensitive to light for more stability and withstand climatic conditions, using a Spray Pyrolysis Equipment technique. The film FTO has been manufactured from doped tin oxide by fluorine ($\text{NH}_4\text{F}:\text{SnCl}_4 = 15\%$) and spraying the solution along the hot glass slide at $450\text{ }^\circ\text{C}$, the surface resistance of the film up to ($10\ \Omega/\square$), the thickness of the film 24 nm, transparent of the film 87%. The photoelectrode for cell (the anode) has been constructed through the coating of conductive FTO layer of porous material of nano titanium dioxide (paste), which was prepared by means of sol- gel method, the particle size up to 30 nm and absorbance of 1.49 nm at the wavelength ($\lambda_{\text{max}} = 344\text{ nm}$). CdS quantum dots have been fixed by using (Sol- Gel) route and stick to using the ultra sonication technique to down to quantum dot particle size to 6-10 nm, absorbance 1.5 nm at the wavelength ($\lambda_{\text{max}} = 420\text{ nm}$), were deposited onto a TiO_2 nanoparticles surface using an ultrasonic-assisted chemical bath deposition method. To make the counter electrode (the cathode) has been coating another glass FTO by using of active layer from the carbon catalyst. The solar cell (Figure 1) parameters are short circuit photocurrent (I_{SC}), open circuit photovoltage (V_{OC}), Fill Factor (FF) and conversion efficiency college (η), was ($110\ \mu\text{A}$), (266 mV), (25%) and (1.2%) for an AM 1.5 irradiation ($100\text{ mW}/\text{cm}^2$), respectively.

Keywords: Nano materials, QDSSC, Quantum dots, Electrolytes, sol-gel, FTO thin films, AFM. XRD.



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Figure 2: Scheme of the QDSSC :

Introducing Facile Wet Etching Route In Fabricating Silicon Nanowires Using Sacrificial Nickel Nanoparticles

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Abstract: In recent years, fabrication of silicon nanowires (SiNWs) arrays have been extensively studied owing to their potential applications in devices such as lithium ion batteries, photovoltaics and nanotransistors [Han *et al*]. There are many methods to fabricate SiNWs including metal-assisted vapor liquid solid growth (VLS) and metal-assisted chemical etching (MacEtch). MacEtch offers great potential due to its scalability, simplicity and low cost of fabrication. However, MacEtch of Si is either accomplished using Ag nanoparticles etching or patterning of Si wafers. The former requires the design and use of expensive Ag nanoparticles solution while the latter requires the employments of top-down approaches such as optical lithography, co-block polymers templating or alumina templating [Huang *et al*] etc., that again increase the cost of fabrication.

In this work, we introduce a new concept towards bottom up approach in large scale fabrication of Si nanowires using MacEtch. The templating in our design make use of sacrificial metal layers that can be removed with wet chemical etching. Choice of sacrificial layers can then be chosen to allow a good de-wetting mechanics and in this work we report on using Ni metal. As illustrated in Fig. 1, the de-wetting begins with a thermal dry oxidation process to grow a thin layer of SiO₂ on top of Si substrate to increase the free surface energy of the substrate. The deposited metal layer can proceed to de-wetting in a reducing environment to produce well-separated Ni nanoparticles on Si substrate. Those Ni particles function as sacrificial blocking mask that can be removed to form Au meshes that can create the nanowires. Moreover, our choice of the metal is such that even if the Ni nanoparticles are not totally removed, they can also act as a masking layer in blocking the catalytic etching.

There are many advantages to this method of fabrication. The sizes of nanowires can be controlled by the initial thickness of Ni film evaporated and the subsequent de-wetting temperature. The choice of metal can be such that etching of the sacrificial layer and the MacEtch can be done concurrently in a single etch process. Finally, the simplicity of the concept ensures possibility of low cost scaling up that is not practical with other templating approaches. In Fig. 2,

we show the corresponding high-resolution SEM images of critical steps in Fig. 1. This is the first demonstration of using a sacrificial approach in fabricating high density Si nanowires using MacEtch and holds great potential in furthering the versatility of the MacEtch technique. Moreover, the as fabricated SiNWs can be used for lithium ion batteries anode for energy storage or anti-reflection to improve light absorption efficiency in photovoltaics application.

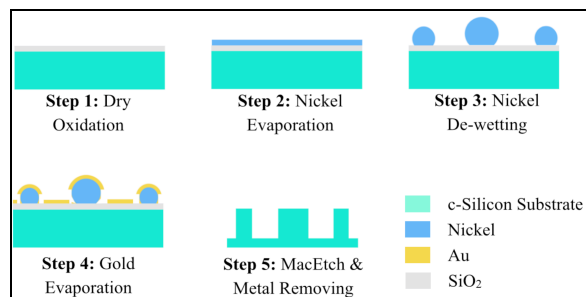


Fig 1. Schematic illustration of fabrication process.

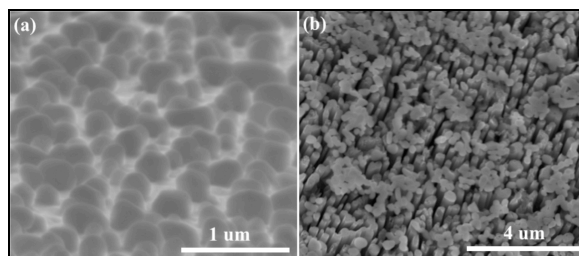


Fig 2. High resolution SEM image of critical fabrication steps in fig 1. (a), 45° tilted view of de-wetting nickel nanoparticles (Step 3). (b), Si nanowires arrays are produced by MacEtch before Au and Nickel removal (Step 5).

Keywords: Silicon nanowire, dewetting, Ni nanoparticles, sacrificial layer, metal-assisted chemical etching, lithium ion battery anode, photovoltaics.

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Nanoscale Hydrophilicity Studies of Gulf Parrotfish (*Scarus persicus*) Scales

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Abstract:

The Gulf parrotfish (*Scarus persicus*) offers inspiration for a strategy to combat marine biofouling, a problem of great economic and environmental interest to the maritime community, through its use of a continually maintained, multifunctional, water-based mucus layer to cover its scales.¹ In this study, to better understand the scale-mucus interface, we investigate the nanoscale hydrophilicity of the fish scales by comparing reconstructed force distance profiles obtained using an amplitude-modulated atomic force microscopy (AM AFM) technique.^{2,3} Combined with the observation from environmental scanning electron microscopy, we note significant differences in wetting behavior between three morphologically distinct regions of each scale as well as between scales from four spatially distinct regions of the fish. This study reveals a previously unreported property of fish scales and proves the value of a new AFM technique to the field of biomaterials.

Keywords: wettability, fish scales, atomic force microscopy, electron scanning microscopy.

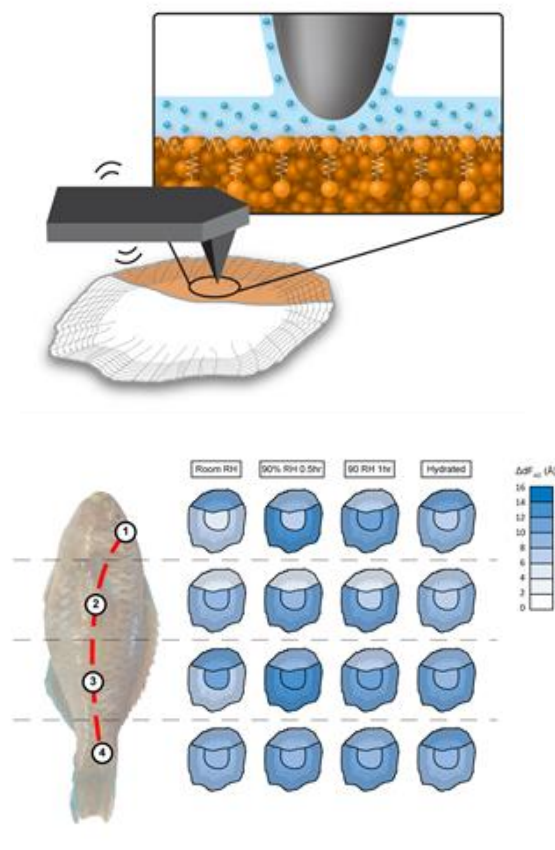


Figure 1: The AFM tip approached the surface and recorded amplitude, phase, and deflection versus distance. Hydrophilicity map of the scales at different stages of humidity treatment was then produced.

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High Young's Modulus, Flexible Multi-Walled Carbon Nanotube Fibers Produced by De-fluorination

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Abstract:

Carbon nanotubes (CNTs) are the strongest and stiffest materials in terms of tensile strength and Young's modulus. However, the mechanical performances of macroscale CNT materials fall far short of the properties of individual CNTs. One of the reasons is an interfacial slip between adjacent constituent nanotubes (Kis *et al.*; 2004).

Fluorination of nanotubes, which changes the hybridization of carbon atoms from sp^2 to sp^3 , prevents the interfacial slip because covalent bonds are formed between adjacent CNTs after de-fluorination (Sato *et al.*; 2008). In this study, we performed de-fluorination of fluorinated multi-walled carbon nanotube (MWCNT) fibers to introduce covalent bonds between sp^3 -hybridized carbon atoms of the adjacent MWCNTs.

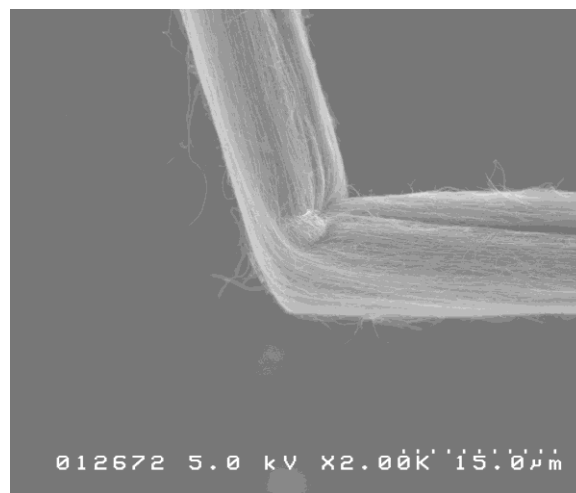
One meter length MWCNT fibers were fabricated by spinning from vertically aligned MWCNT arrays with a height of approximately 250 μm . The fibers were fluorinated using fluorine gas at a given temperature. Subsequently, the fluorinated fibers were de-fluorinated by annealing in an argon gas flow at a given temperature. The mechanical properties of the MWCNT fibers and commercial carbon fibers (CFs) were evaluated by a tensile test. The flexibility of the two fibers were evaluated by a bending test, which applied only a pure bending moment to a test specimen.

Following tensile tests all the layers in each MWCNT were broken simultaneously, indicating that adjacent MWCNTs did not slip. The maximum specific Young's modulus of de-fluorinated MWCNT fiber was 139 N/tex, which is higher than that of commercial CFs (126 \pm 9 N/tex, TR 30S 3L, Mitsubishi Rayon). MWCNT fibers with stiffness ranging from 29 to 139 N/tex did not fracture when the specimens were bent up to 90°. In contrast, the commercial CFs fractured when the specimens were bended 28 \pm 7°. Scanning electron microscopy (SEM) revealed that the high flexibility of the MWCNT fiber is attributed to the deformation of the fiber cross-section and the flexibility of individual MWCNTs (Figure 1). While the de-fluorinated MWCNT fibers showed high flexibility and stiffness, their specific strength (\sim 1.1 N/tex) was lower than CFs (\sim 2.7 N/tex). High resolution electron microscopy showed that some de-fluorinated MWCNTs lost a part of their hexagonal units. There was no difference of MWCNT crystalinities before and after de-fluorination based on Ra-

man scattering spectroscopy. Therefore, the addition of excess fluorine atoms fracture a part of their hexagonal units. In order to improve the tensile strength of MWCNT fibers, we should control a fluorination condition which makes it possible to avoid the destruction of hexagonal units of MWCNTs.

Keywords: carbon nanotube fiber, de-fluorination, flexibility.

Figure 1: SEM photograph of a bent MWCNT fiber.



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Optical characteristics of aluminum-doped ceria nanoparticles

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Abstract: In last few years, cerium oxide (ceria) nanoparticles have been extensively studied because of its high oxygen storage capabilities and the large diffusivity of oxygen vacancies. That makes ceria nanoparticles helpful for gas sensors and oxygen pumps [1, 2]. Doping ceria nanoparticles with some tri-valent elements is a promising technique to improve the ionic conductivity of ceria [3]. Aluminum dopant has been shown its promising potential to improve the catalytic activity of ceria [4]. In this paper, we are studying the impact of aluminum doping in the optical and structural characteristics of ceria nanoparticles. Aluminum-doped ceria nanoparticles, synthesized by chemical precipitation, show reduced optical direct bandgap up to 3.10 eV, larger fluorescence intensity, smaller grain size up to 5.25 nm, with increasing the doping concentration of aluminum. The shown results confirm that the aluminum dopant improves the conversion process from Ce^{4+} ionization states to Ce^{+3} states with more oxygen vacancies [5]. This nanostructures show promising sensitivity to dissolved oxygen based on optical fluorescence quenching technique.

Keywords: ceria nanoparticles, fluorescence quenching, oxygen vacancies, oxygen sensing.

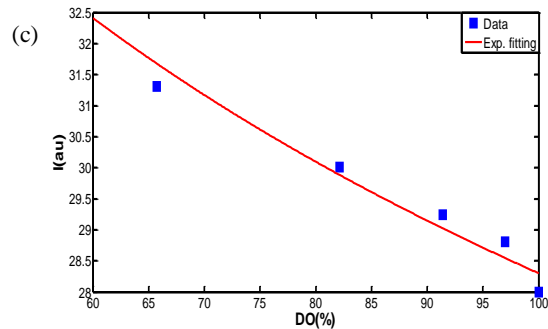
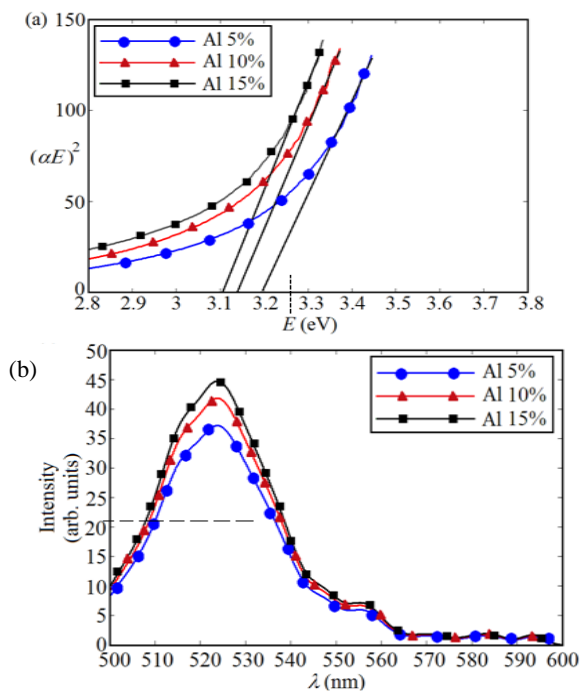


Figure 1: Optical characterization of aluminum-doped ceria nanoparticles: a) direct bandgap calculations based on absorbance dispersion measurements, b) optical visible fluorescence emissions under near UV excitation, and c) response of fluorescent emission of aluminum doped ceria (5 wt.%) nanoparticles to dissolved oxygen. (Hint: dotted lines in “figures a and b” refer to the values of undoped ceria nanoparticles).

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Dy Doped Nanocrystalline SrAl₂O₄: Eu Phosphor: Synthesis, Characterization and Calculation of Kinetic Parameters

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Abstract:

The nanosized Dy doped SrAl₂O₄ samples are prepared combustion synthesis technique (Shafia *et al.* 2010). The SrAl₂O₄ co-doped with Eu²⁺ and Dy³⁺ ions and recrystallized with B₂O₃ flux is regarded as a useful green-emitting long persistence phosphor. The SrAl₂O₄ can be used safely as phosphorescent pigment for luminous watches, clocks and cold-lighting that emits no infrared radiation. We report the results of the characterization and optical studies made on SrAl₂O₄. The XRD, FESEM and HRTEM have been employed to characterize the as prepared samples while optical properties are analyzed through thermoluminescence (TL) and afterglow decay curves.

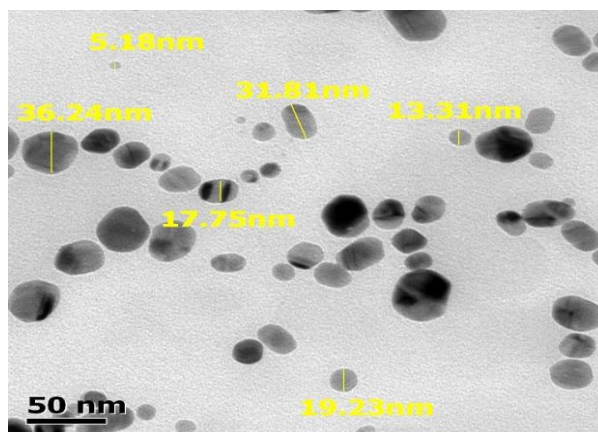


Figure 2: HRTEM image of SrAl₂O₄: Eu, Dy powder sample

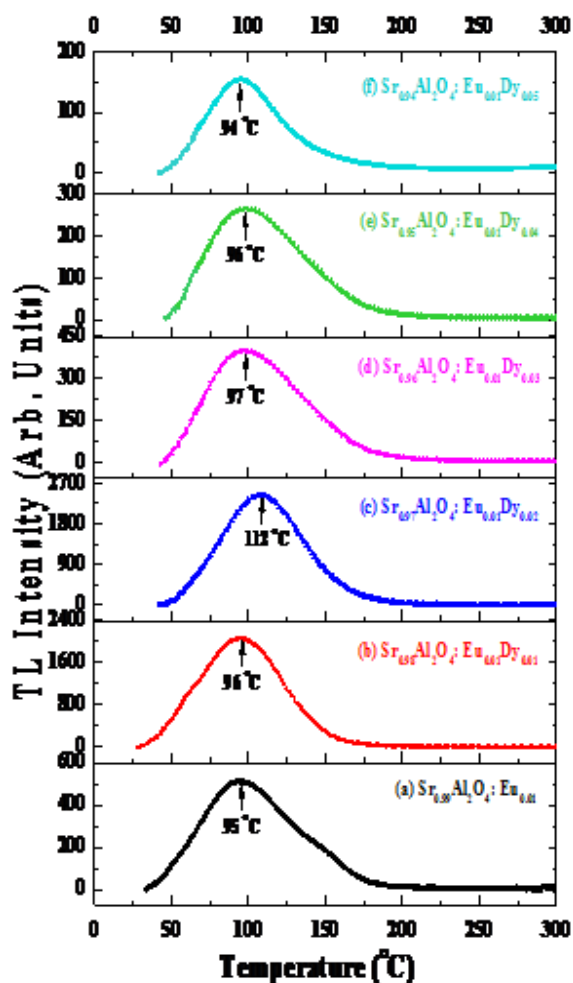


Figure 1: TL glow curves of different nanocrystalline SrAl₂O₄: Eu²⁺, Dy³⁺ phosphor samples

The HRTEM results are quite supportive and encouraging. It proves the particle size to lie in nano range. Mostly, particles are of spherical shape and irregularly distributed. As analysed from XRD results, the peaks corresponding to 2θ values of 23°, 33°, 34°, 35° and 41° resemble (020), (-211), (220), (211) and (031) planes belonging to low temperature SrAl₂O₄ monoclinic α-phase (Xiao *et al.* 2010). All the TL curves peak in a temperature range 94-97°C and the sample Sr_{0.97}Al₂O₄: Eu²⁺_{0.01}, Dy³⁺_{0.02} shows maxima at 112°C (Lu *et al.* 2007). It is also observed that varying concentration of Dy³⁺ does not affect the peak position much. We have applied peak shape method to evaluate various kinetic parameters related to TL glow curves (Chen and Kerish, 1981).

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Omniphobic Transparent Coatings Using Ubiquitous Elements –No Use of Toxy Long Chain Perfluorinated Compounds–

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Abstract: Coatings that repel liquids from their surfaces have potential applications, such as anti-corrosion and anti-fingerprint applications. Perfluorinated compounds, especially long chain perfluorinated alkanes (LPFCs, $\text{CF}_3(\text{CF}_2)_n-$, $n > 5-7$) have been widely applied for the preparation of liquid-repellent surfaces, since they possess low surface energies as well as chemical resistance, thermal stability and so on. However, the chemical and physical effects of the LPFCs on human health and the environment have been viewed lately with concern. In addition, perfluorinated compounds emit corrosive and toxic gasses when they are overheated (above ca. 260 °C). Thus, an alternative approach not requiring LPFCs has is strongly demanded.

Here, we report our recent development for the preparation of eco-friendly omniphobic transparent coatings through a simple sol-gel reaction using organosilanes. Our first approach is based on co-hydrolysis/condensation of alkylsilanes ($\text{CH}_3-(\text{CH}_2)_n-\text{Si}(\text{OR})_3$, $n > 2$) and tetraalkoxysilane ($\text{Si}(\text{OR})_4$).¹⁻²⁾ These hybrid surfaces display extraordinary dynamic dewetting behaviour against not only water but also various organic liquids with low surface tension liquids, on which small volume ($\sim 5 \mu\text{L}$) oil drops can roll-off at low substrate tilt angles ($< 5^\circ$). Such dewetting properties are superior to those of conventional perfluorinated liquid-repellent coatings. Second, we have particularly focused on the formation of silsesquioxane coatings using methyltrialkoxysilane. Thanks to the thermal stability of Si-C bonds, the resulting surface maintained its liquid-repellency after a thermal durability test (e.g., 350 °C in air more than 24h).³⁾ Common features of our coatings are non-perfluorinated, transparent, and ultra-flat ($R_{\text{rms}} < 1\text{nm}$) surfaces, in particular, exhibiting excellent liquid-repellency. We believe that such liquid-repellency may originate from unrestricted motion of surface-tethered functional groups. We believe that our technique is useful to manipulate dynamic surface wettability and might provide a novel, facile alternative to conventional methods for the fabrication of liquid dewetting surfaces relying on surface roughening and subsequent perfluorination using LPFCs.

Keywords: Omniphobic, Hybrid transparent films, Contact angle hysteresis, Dynamic dewetting property, Ubiquitous elements, Substrate tilt angles.

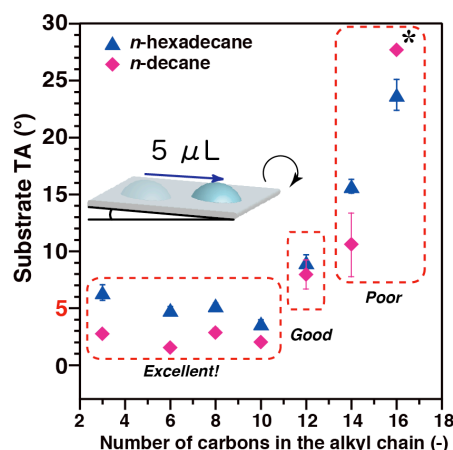


Figure 1: Dynamic dewetting behavior of our hybrid films against various probe liquids (*Substrate TA $> 90^\circ$).

Acknowledgements

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Correlation between Nanostructure and Mechanical Properties of Metals subjected to Severe Plastic Deformation

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Abstract: In this paper the nanostructural aspects of plastic deformation of metals, in particular the conditions leading to the replacement of homogeneous multi-system slip with a stratified rigid (dislocation less) shear strain in trans-granular shear bands, are analyzed. The main focus concerns the description of mechanical properties of the zones supersaturated with point defects which are generated as a result of the change of the deformation path and which determine the superplastic flow of metals. The paper gives scientific foundations for the development of new, unconventional plastic deformation technologies for metals, particularly in the area of severe plastic deformation processes - SPD (Estrin *et al.*, 2013).

Keywords: severe plastic deformation, cyclic change of deformation path, point defects generation, plastic flow viscosity, superplasticity, KOBO method.

Nanostructural phenomena

Low temperature plastic deformation of metallic materials is a result of dislocation slip. For small plastic strain, the deformation process has been well described by the Orowan relation in which plastic strain ε - through the orientation factor M - depends on the length of the Burger's vector b , the density of slip dislocations ζ_m and their mean free path x , in accordance with the following formula: $\varepsilon = M \cdot b \cdot \zeta_m \cdot x$. However, in case of advanced deformation (SPD), the dislocation slip, although indispensable, is merely one of many elements of a complex deformation mechanism leading to localized plastic flow in shear bands.

As is commonly known, shear bands are a result of the change in the deformation path, either self-induced, or forced by external change in the loading scheme, occurring when secondary slip system (or systems), operating in the conditions of "alien" dislocation distribution (initially formed dislocation forest) is activated (Basinski *et al.*, 1965). The crossing of slip dislocations and the forest

dislocations resulting in local anchoring of the slip dislocations (the creation of jogs) and simultaneous folding of the free segments, leads to the formation of dipoles. Dipoles, which in fact are rows of point defects, are immediately disintegrated due to their low migration energy. In case of interstitial (own) atoms it is particularly low and equals only 0.06 – 0.15 eV (Damsk *et al.*, 1963, Terentyev *et al.*, 2004, Sato *et al.*, 2007). This leads to the formation of zones supersaturated with point defects that have weak bonds with the surrounding areas (Korbel *et al.*, 2015).

As suggested in paper (Korbel *et al.*, 2011), metal undergoing a deformation process with a particular about loading scheme can lower its viscosity coefficient η even by 13 orders of magnitude to the value of 10^6 [Pa·s]. In this cause, the viscosity of plastic flow is determined by the presence of generated point defect exceeding the equilibrium level with an estimated concentration of 10^{-8} . Therefore, the strain bore by the shear bands can be treated as localized rigid shear of metal, which remains a solid but behaves like a Newtonian fluid (superplasticity). On the other hand, terminal stability of point defects exceeding the equilibrium level is limited by their annihilation or the formation of so called: „clusters”- lower energy configurations. Hence, in order to maintain a low value of the viscosity coefficient η , the change in deformation path should be cyclically recurred during the whole plastic deformation process. The KOBO method of metal forming (Korbel *et al.*, 2013), in which the main deformation scheme is complimented by cyclic deformation, meets the aforementioned criterion.

It is worth to point out, that nanometric (~ 2 nm) point defects clusters of high density, typical for irradiation processes, have been observed in many deformed metals (e.g. Matsukawa *et al.*, 2003), and a phenomenon of the dislocation-free plastic deformation is linked to the presence of „vacancy-type point defect clusters”.

Experimental

Schemes of two KOBO deformation methods, as well as the obtained products, are presented below (figs 1 -3).

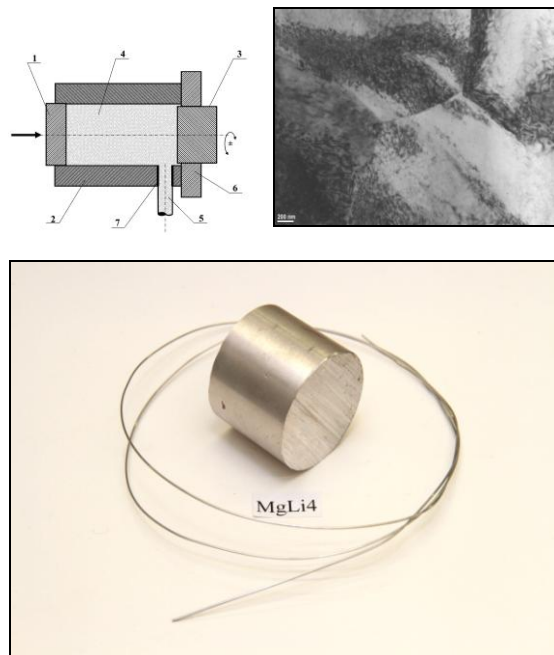


Fig.1. Scheme of the KOBO extrusion process (Korbel et al., 2011) and wire (structure and view) produced from magnesium alloy MgLi4 at room temperature and with extrusion rate $\lambda = 10\,000$, designed to be used as surgical threads.

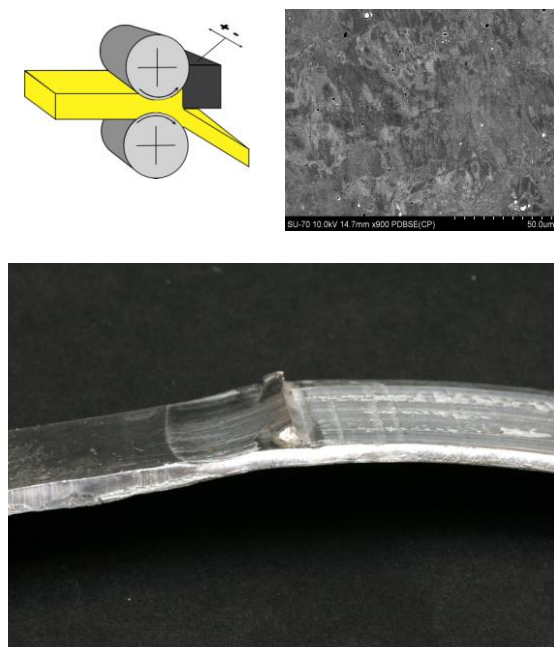


Fig.2. Scheme of a complex rolling by the KOBO method (Bochniak et al., 2015) and strip of aluminum alloy 7075 (structure and view), obtained as the result of this process.

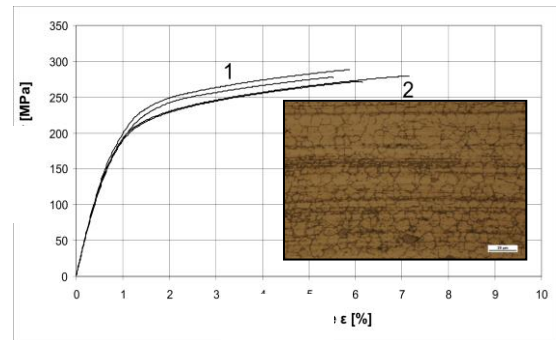


Fig.3. Mechanical properties and structure of wire produced from machining chips of magnesium alloy AZ91, by KOBO extrusion (as in Fig. 1) at room temperature.

To sum up, knowledge on the phenomena accompanying plastic deformation of metals allows for better exploitation of their potential mechanical properties.

Acknowledgments

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Open Access Micro- and Nano-Fabrication Capabilities at the ACT Node of The Australian National Fabrication Facility

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Abstract: ANFF is a Federal Australian Government Initiative through the National Collaborative Research Infra-Structure (NCRIS) to strengthen the Australian academic research stream and to create open-access facilities spanning various fields like biology, chemistry, physics and engineering covered by eight ANFF facilities in the country (three in NSW, one in Victoria, one in Queensland, one in South Australia, one in Western Australia and one in Canberra (Australian Capital Territory/ACT). All facilities are open access to academics and industrial researchers. Each Node has a particular specialisation/theme.

ACT Node is mainly focusing on III-V compound semiconductors with an emphasis on nano-wires for micro- and opto-electronic applications. The Node offers a wide range of micro- and nano-fabrication processes covering many III-V semiconductors like GaAs, InP, GaN but is not restricted to those materials. The Node has been serving many other researchers working on Si for solar cells and for quantum computing, perovskite solar cells, chalcogenide-based photonic circuits at the telecommunication wavelength. Ion implantation and ion beam analysis another major strength of the Node.

An overview of the various Node capabilities will be presented through various processes that have been developed by ANFF staff and made available for our researchers/users.

The core flagship equipment are three metal-organic vapour phase epitaxy reactors (MOVPE) of which two are dedicated to classical III-V semiconductors like GaAs, InP, GaSb and one reactor dedicated to nitride-based semiconductors like GaN, AlN and InN. The Node also offers the full suite of modern micro- and nano-fabrication facilities including nano-imprint lithography, electron beam lithography, reactive ion etching with chlorine and fluorine chemistries, thin film technology that include plasma deposition of silicon oxide-nitride, amorphous and polycrystalline Si, atomic layer deposition, e-beam evaporation of metals and sputtering of a large number of materials (metals, oxides, nitrides...).

Another essential tool is the dual focused ion beam (FIB) FEI-Helios tool that enables new processes at the nano-scale like the traditional lamella preparation for transmission microscopy but also 3-D reconstruction of various materials alongside an in-depth analysis of the rocks opening the door to adequate commercial exploitation of oil and other mineral resources. The FIB also demonstrated capabilities for

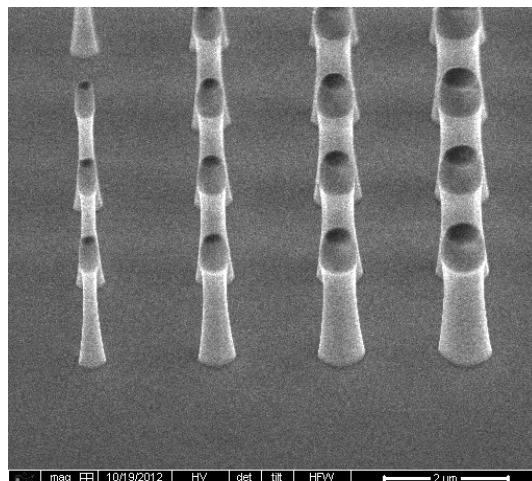


Figure 1- Top down fabrication of InP nano-pillars.

contacting GaAs and InP nanowires and also conductive bio- nanowires.

Figure 1 illustrates a complex technology to fabricate nano-pillars in InP in a top-down approach. First e-beam lithography is used to create the dots using bi-layers of PMMA resist followed by a lift-off process to deposit 70 nm of Cr which serves as a mask to pattern a 500 nm thick layer of SiO_x. The latter is used as a mask to etch 3 μm deep InP pillars using a Cl₂-based process in an inductively coupled plasma reactive ion etching tool.

An in-depth study of silicon nitride deposited by plasma enhanced chemical vapour deposition (PECVD) was carried out correlating the deposition parameters to the structural, compositional and optical properties of the deposited layers through the refractive index, N/Si ratio and the residual mechanical stress [1].

The ACT Node recently expanded the fabrication/characterisation capabilities with a modern high resolution SEM, an FEI Verios, with a cathodoluminescence capability that will become available in the first quarter of 2015.

For a complete overview of the Node capability refer to our Node website: <http://anff-act.anu.edu.au/>

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New Tool for Enhancement of Depth Resolution in Secondary Ion Mass Spectrometry Analysis

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Abstract: Secondary Ion Mass Spectrometry, SIMS, is an effective and powerful technique for analyzing small volumes of almost any non-volatile material and for characterizing very thin structures (Drozdov *et al.*, 2012). This technique is not able yet in spite of great improvements in the depth resolution during the past years, to distinguish between layers that have a thickness of less than a few tens of angstroms or layers that have very sharp interfaces or to separate layers initially spaced by a distance of less than 1nm. The remaining problem, in SIMS analysis, is the limit of the depth resolution, which is governed by several phenomena inherent to the primary ion beam on the substrate. These effects are categorized as instrumental factors, sample characteristics and ion beam induced effects. The depth resolution can be improved by using a low primary energy SIMS apparatus, but some problems can appear: development of a beam induced roughness, increasing analysis time, etc. Another way to enhance the depth resolution is to measure the depth resolution function (DRF) and to exploit its properties in a numerical processing, such as the deconvolution procedure (Allen *et al.*, 1993, Boulakroune *et al.*, 2009). In this work, the real SIMS profiles are obtained by the analysis of delta layers of boron-doped silicon in a silicon matrix, analyzed in a Cameca IMS/6f instrument at oblique incidence. Moreover, the depth resolution function is determined by analyzing delta layers of boron in silicon in different experimental conditions. This function is used for the recovery of the real shape of the profiles and the improvement of the depth resolution which are altered by the analysis. To this end, a new iterative algorithm is used in order to deconvolve some real of boron-doped layers in silicon. This algorithm is based on Tikhonov-Miller regularisation where a priori model of solution is included (Boulakroune *et al.*, 2009). The latter is a denoisy and pre-deconvoluted signal obtained by the application of wavelet shrinkage algorithm. It is shown that this new multiresolution algorithm gives best results without artifacts and oscillations related to noise. This, leads to a significant improvement of the depth resolution and peaks' maximums. In addition, it is shown that the delta layers that are completely convolved by the SIMS experiment are com-

pletely separated and the depth resolution is improved by a factor of 2.

Keywords: SIMS, Depth resolution, DRF, Deconvolution, Noise

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Applications of 2- and 3-dimensional Analysis on Nanostructured Materials using advanced Characterization methods such as XPS, Auger and TOF-SIMS

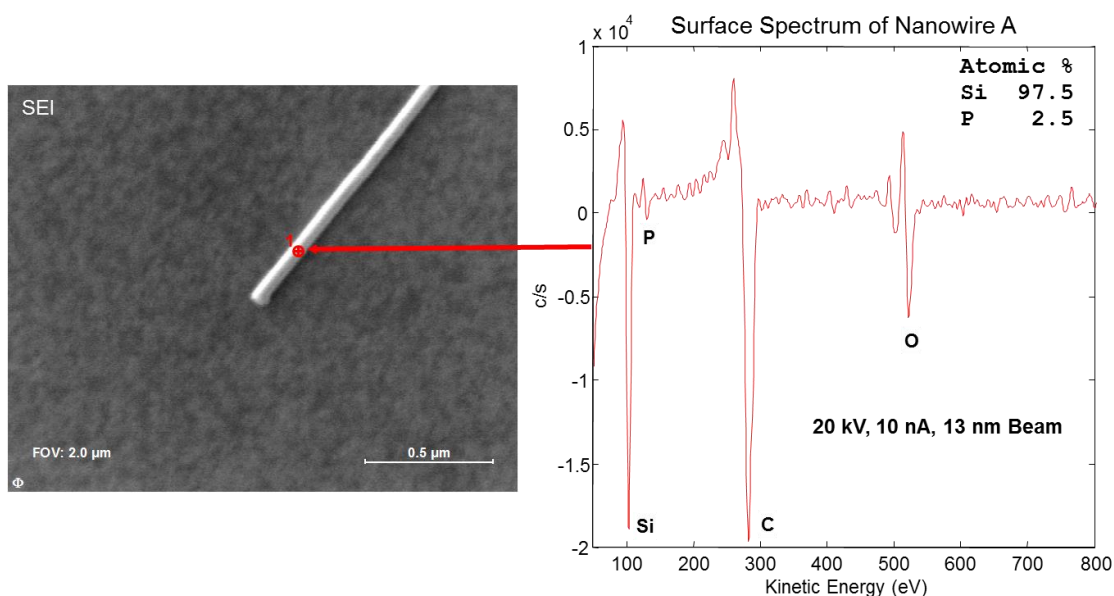
Wolfgang Betz, J. S. Hammond, D. F. Paul, D. Watson, P. E. Larson, R. E. Negri
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Abstract: Modern surface analytical techniques such as Field Emission Scanning Auger Microscopy, X-ray Photoelectron Spectroscopy and Time-of-Flight Secondary Ion Mass Spectrometry can address key analytical questions relevant to develop new materials.

The very shallow probing depth of these techniques of only 0.1 – 10nm, together with the high spatial resolution of down to 6nm make them key contributors for the development of new materials. All these techniques allow the use of in-situ etching for the removal of surface contaminants, the investigation of layered materials and to study diffusion phenomena. Depending on the thickness and composition of the material, different etching sources such as ultra-low energy Argon sputtering, FIB, or C₆₀ Cluster Guns are used.

In this talk, examples of the successful analysis 2D and 3D analysis of Nanostructured material such as single Nanowires and Nanocones will be presented. Furthermore, the analyses of multilayered organic and in-organic films with thicknesses in the nanoscale regime will be discussed.

60 nm Diameter Si Nanowire



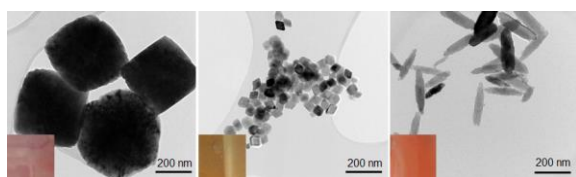
Influence of dielectric properties of Hematite nanoparticles on color rendering of automotive painting

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Abstract: The iron oxides have always attracted considerable interest on account of their tinting properties. In painting, pigments that interact each other to form aggregates modify the light diffusion and then the sensed color by an effect related to their morphology, size and dielectric properties. In this study, Hematite nanoparticles were synthesized with varying shapes and sizes by the hydrothermal method (Figure 1). The peculiarities of particles will be particularly emphasized since they are likely to affect the dielectric properties. Otherwise, the reverse approach will be considered that consists in adjusting the chemical composition of the material to reach the desired tint. As a first study, the influence of the composition on dielectric properties will be regarded.

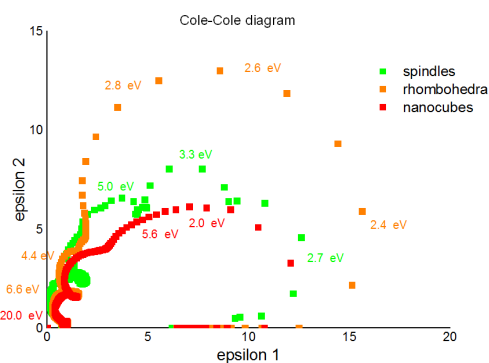
Figure 1: conventional TEM images of Hematite nanoparticles obtained by controlled hydrothermal route:



The dielectric response of materials was measured by Electron Energy Loss Spectroscopy (EELS). This analytical technique allows to characterize the chemical and electronic structure of the material through its interaction with the electron beam. In particular, the low-loss region of the spectrum contains the full information of the local dielectric function of the material (including optical properties) which can thus be retrieved from a KK transformation of the EEL spectra (Thorel *et al.*; 2001). The dielectric response of materials is commonly represented according to the Cole-Cole diagram (Figure 2).

Keywords: Hematite, nanoparticles, hydrothermal synthesis, dielectric properties, EELS, color rendering, automotive painting.

Figure 2: Cole-Cole diagrams obtained for different shapes of Hematite nanoparticles:



Over a second phase, a quantitative morphological description of the spatial auto-organization of nanoparticles within a coating was characterized from 2D images recorded by TEM or SEM at different scales. The morphological characteristics of the coating allow for identifying the random coating model implemented afterwards in the numerical simulation. These models are based on scale transitions from nanopigments to material and describe the material's interaction with light. To feed the coating model, it is essential to measure the dielectric function of the nanoparticles alone and then inside the coating taking into account the dielectric response of the polymer matrix. From the segmented images and knowing the local dielectric function at each area of the microstructure, a permittivity domain map calculated by FFT (Couka *et al.*; 2015) could be extracted at the macroscopic scale.

This work contributed to the development of a tool which enable to predict the color rendering from the chemical composition. So, the designers will no longer have to deal with real samples to visualize appearance of materials. The project aims at developing a twofold approach : from composition to appearance and from appearance to composition. From the composition, the appearance of the resultant material is modeled, and conversely the composition can be predicted from a desired color rendering. Thus, the project relates the virtual visualization of a manufacturable material and the expression of its physical composition.

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Nanocomposite nanowebs with self-cleaning property

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Abstract:

The electrospinning method enables the production of functionalized membranes with the incorporation of nanoparticles into a polymer matrix (Daels *et al.* 2014). Among different types of nanoparticles, TiO₂ nanoparticles are known for great availability, non-toxicity, stability, low cost and efficiency (Daels *et al.* 2014; Mohabansi *et al.* 2011) and have received remarkable attention for the self-cleaning applications since they effectively decompose organic contaminants under UV light (Su *et al.* 2013; Li *et al.* 2013). The exposure of TiO₂ nanoparticles to UV light with an energy that matches or exceeds their band gap energy leads to an excitation of electrons from the valence band to the conduction band, leaving holes in the valence band. These electrons and holes lead to the formation of hydroxyl and oxygen radicals, which react with contaminants resulting in their decomposition (Daels *et al.* 2014; Bedford *et al.* 2010; Deveau *et al.* 2007; Yang *et al.* 2005). In this study, polyacrylonitrile nanowebs containing TiO₂ nanoparticles were successfully prepared by electrospinning technique (Figure 1). TiO₂ content was varied as 1 wt% and 10 wt%. Morphology, mechanical properties and photodegradation ability of the nanowebs were investigated. Uniform nanofibers were obtained. While breaking stress increased with 1 wt% TiO₂ addition, decrease was observed at the TiO₂ content of 10 wt%. The results of photodegradation with methylene blue aqueous solution demonstrated excellent photocatalytic activity of TiO₂ incorporated PAN nanowebs. TiO₂ incorporated nanowebs with the self-cleaning property may find applications in medical textiles, filtration, etc.

Keywords: Electrospinning, functionalization, nanofiber, nanocomposite, self-cleaning, TiO₂.

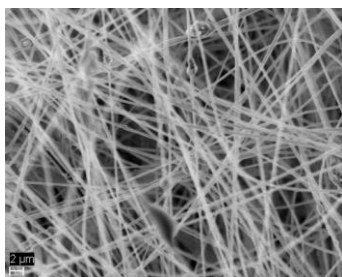


Figure 1. SEM image of 10 wt% TiO₂/PAN nanoweb.

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Effects of different configurations of curved-wall jet (CWJ) burner on the flame synthesis of titanium dioxide nanoparticles

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Abstract: Titanium dioxide (TiO₂) is an important semiconducting metal oxide and is expected to play an important role in future applications related to photonic crystals, energy storage, and photocatalysis. A novel curved wall-jet (CWJ) burner was designed for flame synthesis [1]. This was achieved by injecting precursors of TiO₂ through a central port into different flames zones that were stabilized by supplying fuel/air mixtures as an annular-inward jet over the curved wall [2]. This provides a rapid mixing of precursors in the reaction zone with hot products. In order to increase the contact surface between the precursor and reactants as well as its residence time within the hot products, we proposed two different modifications. The CWJ burner was modified by adding a puppet valve on top of the central port to deliver the precursor tangentially into the recirculating flow upstream within the recirculation zone. Another modification was made by adopting double-slit curved-wall jet (DS-CWJ) configuration, one for the reacting mixture and the other for the precursor instead of the central port. Particle growth of titanium dioxide (TiO₂) nanoparticles and their phases were investigated. Ethylene (C₂H₄) and propane (C₃H₈) were used with varying equivalence ratio and Reynolds number and titanium tetraisopropoxide (TTIP) was the precursor. Flow field and flame structure were quantified using particle image velocimetry (PIV) and OH planar laser-induced fluorescence (PLIF) techniques, respectively. The nanoparticles were characterized using high-resolution transmission electron microscopy (HRTEM), X-ray diffraction (XRD), and BET nitrogen adsorption for surface area analysis.

The flow field quantified by PIV consisted of a wall-jet region leading to a recirculation zone, an interaction jet region, followed by a merged-jet region (Fig. 1). The modified CWJ burner revealed appreciable mixing characteristics between the precursor and combustion gases within these regions, with a slight increase in the axial velocity due to the precursor injection. This led to more uniformity in particle size distribution of the synthesized nanoparticles with the puppet valve (first modification). The double-slit modification improved the uniformity of generated nanoparticles at a very wide range of stable experimental conditions. Images of OH fluorescence showed that flames are tightly attached to the burner tip and TTIP has no influence on these flames structures. The particle size was slightly affected by the operating conditions. The phase of TiO₂ nanoparticles was mainly dependent on the equivalence ratio

and fuel type, which impact flame height, heat release rate and high temperature residence time of the precursor vapor. For ethylene flames, the anatase content is proportional to the equivalence ratio [3], whereas it is inversely proportional in the case of propane flames. The anatase content increased from 70% to 96% associated with the increasing of the equivalence ratio from 1.0 to 2.2 in ethylene cases and reduced from 90% to 80% when reducing ϕ from 1.6 to 1.2 for propane. The anatase content reduced by 8% as we changed Re between 8,000 and 19,000, implying that the Re has a slight effect on the anatase content. The synthesized TiO₂ nanoparticles exhibited high crystallinity and the anatase phase was dominant at high equivalence ratios ($\phi > 1.6$) for C₂H₄, and at low equivalence ratios ($\phi < 1.3$) for the C₃H₈ flame.

Keywords: Flame synthesis, Titanium dioxide, Curved-wall jet burner, Turbulent premixed flame.

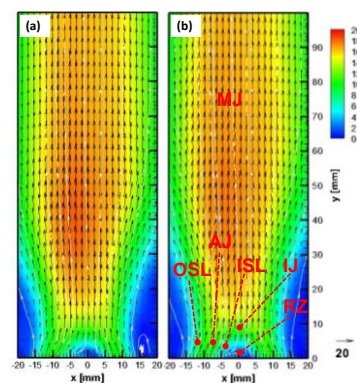


Figure 1: Time averaged velocity vectors plot of flow field for propane flame of $Re=18,871$ and $\phi=1.3$ configured in DS-CWJ burner; (a) without and (b) with TTIP precursor (white lines indicate streamlines).

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Metal Nanoparticle Stabilization via Block Copolymers

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Abstract:

In addition to applications in various fields including personal care products, block copolymer micelles have been extensively investigated as surfactants for solubilizing active agents for drug delivery, or as nanoreactors for the production of inorganic nanoparticles, e.g. of metals with potential applications in catalysis (Hamley 2004). However, the practical applications of micelles are limited due to their structural instability since the micellar structure can hardly keep stable upon dilution or changes of external conditions such as changes in pH, ionic strength, solvent change and temperature (Read and Armes 2007). In order to enhance the stability, core-crosslinked (CCL) and/or shell-crosslinked (SCL) micelles were then developed (Read and Armes 2007). SCL micelles are generally prepared at high dilution in order to avoid undesirable intermicellar cross-linking and thus the efficiency is quite low. Probably the more suitable method is to carry out core crosslinking (CCL) instead of SCL (Bütün, Wang et al. 2000).

Monometallic and bimetallic nanoparticles (NPs) have attracted much attention in the fields of physics, chemistry, and biology owing to their unique chemical and physical properties as well as their potential technological uses in magnetism, electronics and catalysis. Their potential technological uses are strongly dependent on the sizes, compositions, and shapes of metal nanomaterials. Bimetallic NPs has better catalytic activity than that of their monometallic counterparts (Gates 1995, Liz-Marzan and Philipse 1995, Forster and Antonietti 1998, Cohen 1999, Hamley 2003, Bradley 2007, Jain, Huang et al. 2008). The micelle formation due to interaction or complexation of metal compounds with polymer side functional residues, fine control on colloid morphology can be provided, which leads to monodispers particles (Chan, Craig et al. 1992, Sidorov, Bronstein et al. 1999).

Herein, we report the synthesis and successful stabilization of different mono- and bimetallic nanoparticles such as Ag, Au, Pt, Ag-Au, Au-Pt and Ag-Pt with block copolymer micelles. Also, CCL micelles have been synthesized nano-metal synthesis in the micellar core. Poly(ethylene glycol)methyl ether-*block*- poly(methacrylic acid) (MPEG-*b*-PMAA, Fig. 1), poly(ethylene glycol)methyl ether-*block*-poly (3-((2-(methacryloyloxy) ethyl) dimethyl ammonio) propane-1-sulfonate) (MPEG-*b*-PDMAPS, Fig. 2) ve poly(ethylene glycol)methyl ether-*block*-poly(glycidyl methacrylate) (MPEG-*b*-PGMA, Fig. 3) blok copolymers were used in the synthesis of nanometals. For core-crosslinked system preparation, MPEG-*b*-PGMA block copolymer micelles were prepared in aqueous media. CCL micelles were synthesized via crosslinking the epoxy functional groups of poly(glycidyl methacrylate) block with ethylenediamine (Fig. 4).

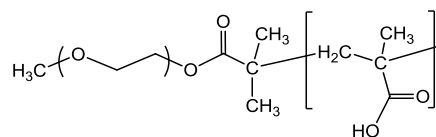


Figure 1. MPEG-*b*-PMAA block copolymer

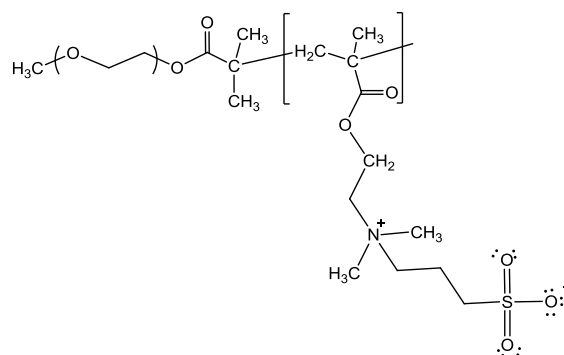


Figure 3. MPEG-*b*-PDMAPS block copolymer

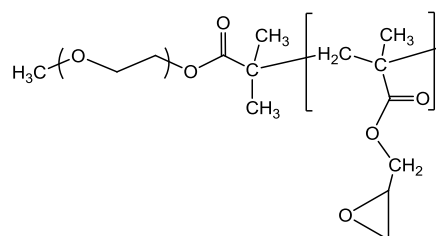


Figure 3. MPEG-*b*-PGMA block copolymer

To load metal source in micellar system via complex formation, AgNO₃, H₂PtCl₆ and HAuCl₄ metal salts were used. Then, the aqueous solution of NaBH₄ was added to the micellar medium as reductant and metal nanoparticles were synthesized. Transmission Electron Microscopy (TEM) images, UV/Vis spectroscopy and Dynamic Light Scattering (DLS) studies showed that the synthesis of metal us be successful. TEM image of Au NPs showed that Au NPs were in core of CCL micelles (Fig. 5).

The catalytic efficiencies of metal-CCL micelle dispersions were investigated in the reduction of *p*-nitrophenol with NaBH₄. Nanometal-micelle dispersions showed good catalytic activity in a related model reaction. Also, catalytic activities of bimetallic nanoparticles are greater than that of monometallic nanoparticles which are well agree with the literature.

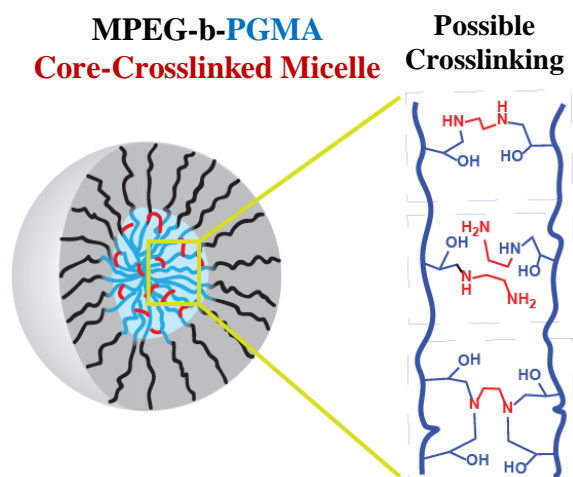


Figure 4. Schematic representation of the MPEG-*b*-PGMA core crosslinked micelles

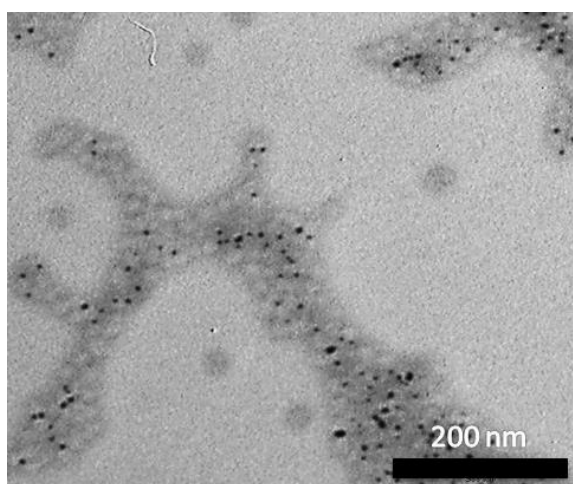


Figure 5. TEM image of Au NP/MPEG-PGMA CCL micelle solution

Keywords: Micelles, CCL micelles, core-crosslinked micelles, diblock copolymer, bimetallic nanoparticles, Ag NPs, Au NPs, Pt NPs,

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Effect of Processing Parameters on the Morphology of Al₂O₃-TiO₂ Nanocomposites for High Temperature Applications

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Abstract: During last few decades nanocomposites have assumed an important position in industries as they are being used successfully in a wide number of applications, especially in automobile, aerospace, electronic and cryogenic industries. Among different composites, alumina (Al₂O₃) and titania (TiO₂) based composites show high toughness, low thermal expansion, low thermal conductivity, cryogenic compatibility, high adhesion strength, thermal barrier as well as resistance to high thermal shock [Wan *et al.*, 2007]. Various techniques used for the development of the polymer assisted composites include solid state, sol-gel, plasma spraying and laser- re melting [Li *et al.*, 2013] etc. Amongst all, chemical route is used widely because it gives more homogenous product with reduced particle size. The various factors which influence the properties of such type of composites include stirring time, temperature and concentration of surfactant.

The present paper reports the effect of processing parameters on the properties of Al₂O₃-13%TiO₂ Nanocomposites for Wide Engineering Applications. The specimens for the present investigation were synthesized via polymer (Pluronic P-123) assisted co-precipitation technique [Mosayebi *et al.*, 2012]. The influence and effect of concentration of the surfactant on the morphology and size of the obtained materials were investigated. Pluronic P-123 polymer exhibits both hydrophobic as well as the hydrophilic nature simultaneously (Figure 1). Due to this nature agglomeration possibility is reduced and controlled particle size is obtained. Phase and particle size was investigated using XRD and FESEM. It was observed that the particle size for polymer assisted composite is found to be less than the sample prepared by simple co-precipitation technique. It is expected that the results of the present work will be helpful in developing quality composites for high temperature applications.

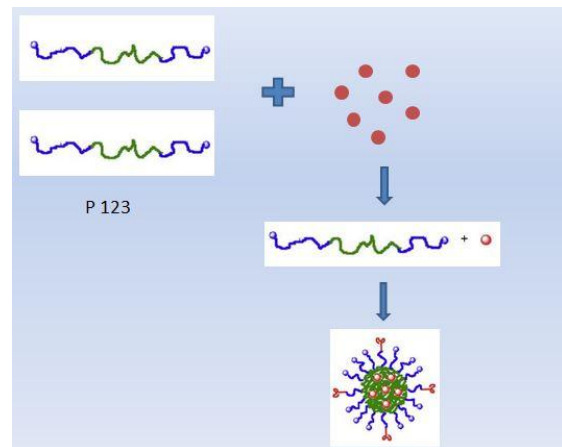


Figure 1: Mechanism of polymer with the sample particles showing hydrophobic and hydrophilic nature simultaneously

Keywords: Polymer Assisted Composites; X-Ray Diffraction (XRD); Field Emission Scanning Electron Microscopy (FESEM); Density.

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Investigating of the flammability, impact strength, and physical properties of wood flour/polypropylene composites

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Abstract

This study aims to investigate the effect of the content of wood flour on flammability, Impact strength, and physical properties of wood flour/polypropylene composite. For this purpose, the content of wood flour was considered taken at 40, 50, and 60%, with the size of the remaining flour on sieves being of mesh 60, and the MAPP content being 2 wt %, respectively. Properties of flammability, impact strength, and water absorption and thickness swelling were measured according to relevant ASTM standards. The obtained results showed that increasing the wood flour content to 60 wt.%, the impact strength decreased. The water absorption and thickness swelling of composites was lowered with the decrease in wood flour content. With increasing the wood flour content to 60 wt.%, the limiting oxygen index increased.

Keywords: flammability, Impact strength, water absorption, and thickness swelling

Hybrid DSC performance with rutile-phased TiO₂ nanorods and nanoflowers fabricated through hydrothermal method

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Abstract: Both aligned Titanium Dioxide (TiO₂) nanorods and nanoflowers were deposited on the fluorine-doped SnO₂ transparent conducting glass oxide by a hydrothermal method. Characterizations of the hybrid DSC using rutile-phased TiO₂ nanorods and nanoflowers were performed such as surface morphology, structural property, dye-absorption and power conversion efficiency of the device. In the hybrid DSC preparation, both nanorods and nanoflower TiO₂ were used as photoelectrode, platinum (Pt) were used as counter electrode, ruthenium dye N719 and DPMII electrolyte were used as dye

solution and electrolyte, respectively. In order to enhance the porosity of TiO₂ film, 0.001M of Polyethylene Glycol (PEG) were added in the preparation of rutile-phased TiO₂ nanorods and nanoflowers. The thickness of the TiO₂ nanorods and nanoflowers is 5µm and 15µm, respectively. Lastly, I-V measurement of the hybrid DSC, was done under light intensity of 100mW/cm². It was found from the results that open circuit voltage (V_{oc}), short circuit current density (J_{sc}), fill factor (ff) and energy conversion efficiency (η) was 0.786 V, 7.753 mA/cm², 0.537 and 3.27%, respectively.

Keywords: Titanium Dioxide; rutile; nanorods; nanoflowers; dye-sensitized solar cell

Nano-mechanics of DNA in severe conditions

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Abstract:

DNA is perhaps the most important of all biomolecules, not only because it carries the genetic information of biological systems, but also because of its mechanical flexibility that helps its biological function. Thus, elasticity of DNA plays an important role in its biological function. With a typical length of a few micrometers to several centimeters, it is only two nanometers wide. When the molecule is free in aquatic environment and in physiological conditions it behaves like a flexible rod, but the molecule is usually found in very tight geometries (see figure 1). In eukaryotic cells, it tightly fits inside micron-sized cell nuclei, with many sharp bends in nano scale. As another example, it can be encapsulated and found in highly confined structures in viral capsids with a size of tens of nanometers. Thus, understanding the structure of the molecule under such severe confinements and the way the molecule responds to these geometrical constraints, may help to understand DNA function better.

In this talk we overview the theoretical models and their results in molecular structure of DNA in nanoscale, and its mechanical response to external perturbations.

Keywords: DNA, nano-elasticity, DNA packaging.

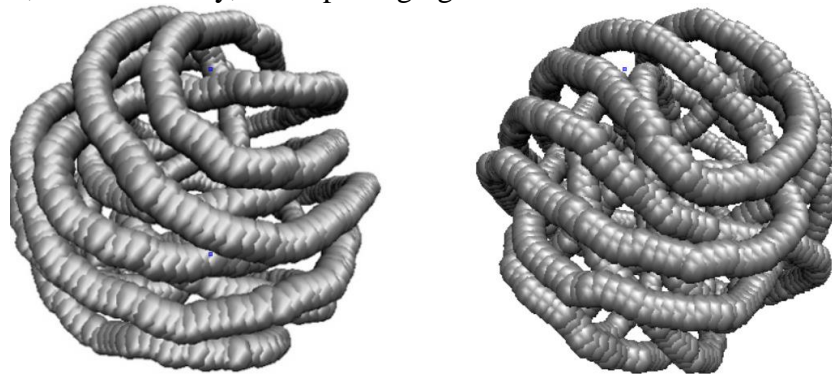


Figure 1: Typical configurations of a packed DNA inside a 10

Insights on the use of metallodendrimers to fight cancer and other diseases

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Abstract: Metallodendrimers are a class of compounds related with the larger family of dendrimers. The search for metallodrugs displaying less toxicity, and enhanced anticancer activity, especially for cancer types that do not respond well to platinum compounds, is of high interest (Muhammad *et al.*, 2014). Ruthenium complexes, due to the variety and accessibility (under physiological conditions) of oxidation states (Ru(II), Ru(III) and Ru(IV)), rich synthetic chemistry, generally low cytotoxicity and proposed capability to preferentially accumulate in neoplastic tissues present an alternative approach to the clinically used platinum chemotherapeutic agents (Bergamo *et al.*, 2011). Also, the development of polynuclear metal complexes, such as metallodendrimers with copper, platinum or ruthenium, proved to be a good option to improve the potency of anticancer drug candidates (Gianferrara, *et al.*, 2011, El Kazzouli, *et al.*, 2012). Surprisingly, in the last two decades, only a few examples of metallodendrimers with potential application as anticancer drugs were reported, and most of them used diaminobutane polypropylene imine (DAB-PPI or DAB-POPAM) or poly(amidoamine) dendrimers (PAMAM) as cores (Rodrigues *et al.*, 2011).

In this oral presentation we will start by introducing the topic of metallodendrimers (*e.g.* What are they? Why can they provide a new approach in the fight against cancer and other diseases?), and then do the state of the art in the area and conclude with our contribution to the field. The fact that cationic dendrimers can easily interact with the cell surface, enter into the cytoplasm and reach, in short time, the nucleus of the cells (Pandita *et al.*, 2011), prompt us to develop low-generation poly(alkylideneamine) dendrimers functionalized with nitriles coordinated to the organometallic moiety $[\text{Ru}(\eta^5\text{-C}_5\text{H}_5)(\text{PPh}_3)_2]^+$, for use as chemotherapeutic agent (Figure 1). As far as we are aware, this series of air-stable cationic zero generation ruthenium-based metallodendrimers was the first to be prepared and characterized (by UV/Vis, IR, EA, NMR and MS) using nitrile-functionalized poly(alkylideneamine) dendrimers as cores. The degradation behavior of the metallodendrimers was studied by ³¹P NMR in [D₆]DMSO, along the time, at physiological temperature, revealing the potential of the compounds to be explored for biomedical applications. The cytotoxicity studies of the prepared

compounds to six cell lines will be also presented and discussed.

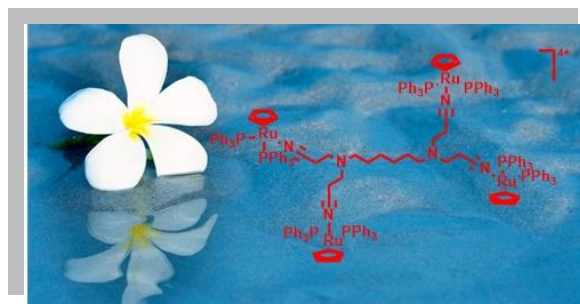


Figure 1: Low-generation poly(alkylideneamine) dendrimers functionalized with the organometallic moiety $[\text{Ru}(\eta^5\text{-C}_5\text{H}_5)(\text{PPh}_3)_2]^+$.

Keywords: anticancer drugs, cancer, dendrimers, emergent diseases, metallodrugs, metals.

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Protective and trophic properties of GDNF and its modifications for cells.

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Abstract:

GDNF is a major factor for a survival of the dopamine neurons of the midbrain.

It supports the axon growth as well as survival of the neurons of that type. For the different models of the Parkinson disease it has been shown that GDNF could prevent the neurotoxically provoked death of the dopamine neurons and supports recuperation of its functional activity. Though some by-side effects are also known, like loosing of weight and possibility of neoplastic transformation. We prepared a genetic construct caring human GDNF, introduced it into HEK293 cells, and then transplanted the cells into parenchyma of the mouse brain. It has been shown that transgenic cells which express GDNF essentially reduce the glial scar formation (Pavlova *et al.*; 2006). Therefore GDNF could be applied during transplantation into the brain to improve the transplant survival.

Though in humans GDNF gene supply two versions of mRNA: pre-(α)pro-GDNF and truncated pre-(β) pro-GDNF. Pre-(α)pro-GDNF is secreted through Golgi apparatus and pre-(β) pro-GDNF is located in the secretory vesicles and moves by fast secretion pathway. It is possible that pre-(α)pro-GDNF is needed for conventional neuron survival, and pre-(β) pro-GDNF serves as SOS system during traumatic injury of neurons or neurodegenerative diseases. To study 'pro' region function during fast transport and factor induction properties several versions of modified GDNF were made. A secretion of the factor into medium has been shown by western blot analysis. All modified GDNF were introduced into HEK293 cells, and transgenic cell lines were maintained. The condition media after culturing the cells with modified GDNF was added into culture medium of rat embrional spinal ganglion explant and a growth of neural sprouts were analyzed. Deletion of 'pro' region essentially increases of GDNF effects as neural inductor. A study of culture of dissociated spinal ganglion and calculation of neural sprouts yielded the same results. Research is supported by Grants from RFBR, Ministry of Science and Education

Keywords: GDNF, 'pro' region, neurodegenerative diseases, transgenic cells.

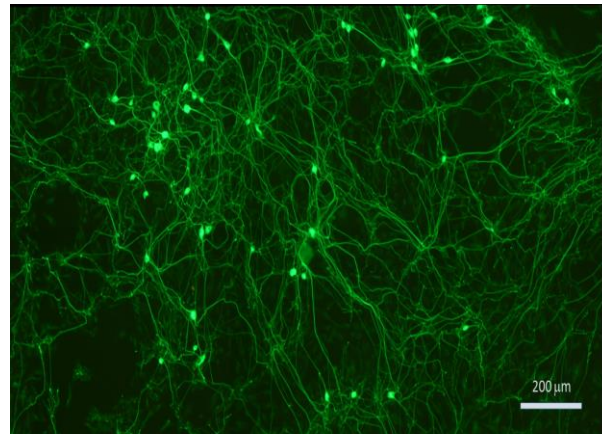


Figure 1: Effect of media conditioned by transgenic cells and medium supplemented with mGDNF on cultures of dissociated spinal ganglia. Spinal ganglion cells gave rise to long β 3-tubulin-positive processes (neuronal axons) in medium conditioned by HEK293/mGDNF/GFP. The scale was 200 μ m.

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Nanomodule-Activity Relationship of G-quadruplex Based DNA Aptamers for Human Thrombin

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Abstract:

G-quadruplex based DNA aptamers for human thrombin are promising pharmaceuticals as anticoagulants. Initially discovered 15-mer DNA aptamer (15-TBA) has a minimal G-quadruplex structure which is able to inhibit thrombin. 15-TBA was modified and extended to improve aptamer activity and *in vivo* stability providing 31-TBA, NU172, RA-36, and some others as successful examples. In this paper an interplay between G-quadruplex (pharmacophore nanomodule) and additional nanomodules has been studied. An original turbidimetric assay and conventional coagulation tests were applied to evaluate both inhibitory activity and type of inhibiting for aptamers constructed by exchanging the nanomodules between 31-TBA and NU172. Additional nanomodules strongly affect pharmacophore nanomodule inhibitory activity either enhancing or reducing it. RA-36 aptamer has two putative pharmacophore entities which also interplay being functionally non-equal. 5'-truncated RA-36 has half of the activity of RA-36, and the same as for 15-TBA. On the contrary 3'-truncated RA-36 has intermediate activity in between 15-TBA and RA-36. These results indicate fine regulation of G-quadruplex inhibitory activity by additional nanomodules, as well as non-trivial behavior of joined pharmacophore nanomodules.

Keywords: anticoagulant, DNA aptamer, hemostasis, inhibitor, nanomodular structure, thrombin.

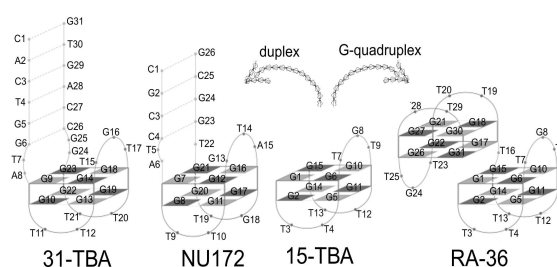


Figure 1: The scheme of 15-TBA, and putative structures of 31-TBA, NU172, and RA36

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Synthesized and characterization of bioactive enamel coatings for dental veneering porcelain modified by bioactive glass

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Abstract:

A new composite leucite glass–ceramic has been prepared by mechanochemical synthesis route for dental veneering restoration. The developed material aims to modify the surface of dental ceramics creating bioactive surfaces able to improve material–cell interaction enhancing the bonding of the marginal gap between restoration and tooth. The application of the mechanochemical method led to a homogeneous leucite glass–ceramic which can be applied as coating on commercial veneering dental ceramic substrates. The microstructural, thermal, mechanical and biological properties of the fabricated coatings and material–cell interaction of the composite have been studied. The attachment and proliferation of both periodontal ligament and gingival fibroblast cells confirmed the bioactive behavior of the new composites. Due to this they are potentially able to apply in dental restorations for regeneration of soft tissue and sealing of the marginal gap.

Keywords: Mechanochemical synthesis; Porcelain fused to metal; CTE; Cell culture study.

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Effect of Polysaccharide Chemistry on the Solution Concentration of Nanoparticle Complexes of Polysaccharides and Antiviral Drugs

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Abstract: The Human Immunodeficiency Virus (HIV) affects the immune system and is responsible for causing acquired immunodeficiency syndrome (AIDS). Currently, more than 33 million people are HIV-positive (AIDS epidemic update, World Health Organisation, 2009-2010). Most of the antiviral drugs used for the treatment of HIV has low solubility and high dosage thus a very low oral bioavailability. A relatively high dose of the drug is required to maintain therapeutic concentrations for longer periods, this lead to several side effects. Oral administration of therapeutic agents is the easiest and frequently preferable mode of drug delivery, as there is no requirement for hospitalization which requires medical infrastructure, a critical issue in underdeveloped countries (Lavelle *et al.*; 1995). However, it is important and challenging to attain the desired pharmacokinetic profile for a given drug, especially one with poor aqueous solubility (Daugherty *et al.*; 1999). There are several factors in the GI tract which can limit the bioavailability of drugs such as tissue barriers (mucosa, microvilli) and physiological factors (varying pH, enzymes, transporter mechanisms). Amorphous solid dispersions (ASDs) have attracted great interest due to their utility in formulating poorly soluble active pharmaceutical ingredients (APIs) to attain effective solubility and bioavailability (Williams *et al.*; 2013). Miscibility between the polymer and drug is an important factor in the preparation of amorphous solid dispersions of polymer-drug systems and is a measure of the ability of the polymer to dissolve the crystalline drug. Nanoparticles with well-defined size distributions have the potential to release large fractions of their drug load in the first few hours in the small intestine (Vedula *et al.*; 2014). In this work, nanoparticles of amorphous dispersions of antiviral drugs, with several novel polysaccharides (cellulose esters and a pullulan derivative) were produced by a rapid precipitation process. Particles were purified by dialysis and dried powders were recovered after freeze drying. Particle diameters as measured by dynamic light scattering were in the range 100-200 nm. The nanoparticles showed significant aggregation after freeze drying but this was reduced by using trehalose as a cryoprotectant.

The drug loading efficiencies for the polysaccharide nanoparticles ranged from 62-96%. All the nanoparticles afforded increased solution concentration and faster release compared to the pure drugs.

Keywords: Antiviral drugs, cellulose ester, pullulan, nanoparticles, flash nanoprecipitation, multi-inlet vortex mixer, solubility parameter, drug release.

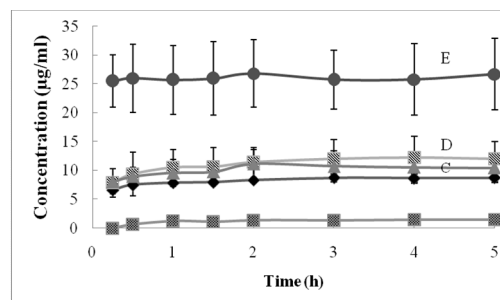


Figure 1: Solution concentration of antiviral drug (A) as received, (B), (C) and (D) from polysaccharide nanoparticles of different chemistry. The error bars represent standard deviation of results from 3 batches. The solubility parameter plays an important role in drug release.

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MWI Synthesis and Characterization of Highly Conductive R-(GO-(PS-PMMA))/AgNPs Nano composites and its Antibacterial Activity against *E.Coli*

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Abstract: This work presents study on the facile method for preparation of copolymer of styrene and methylmethacrylate containing reduced graphene oxide/silver nanoparticles (PS-PMMA/RGO/AgNPs) nanocomposites using two different preparation techniques (i) a microwave irradiation (MWI) to obtain R-(GO-(PS-PMMA))/AgNPs nanocomposites and (ii) in situ bulk polymerization method to obtain RGO/AgNPs-(PS-PMMA) nanocomposites. The nanocomposites were characterized by FTIR, XPS, and Raman spectroscopy and XRD, SEM, HRTEM, DSC and TGA analysis techniques. These results showed that the MWI produced nanocomposites with enhanced morphological, structural and thermal properties as compared with nanocomposites by insitu method. The antibacterial activity of RGO/AgNPs-(PS-PMMA) and R-(GO-(PS-PMMA))/AgNPs nanocomposites against *E.coli HB 101 K-12*, shows an inhibition zone of 3 mm and 27 mm respectively. This result indicates that the nanocomposites prepared by MWI shows strong activity. Also the conductivity results shows that the nanocomposites prepared using MWI shows better conductivity than the insitu prepared nanocomposites

Keywords: Graphene; Graphene oxide; Silver nanoparticles; MWI; PS-PMMA.

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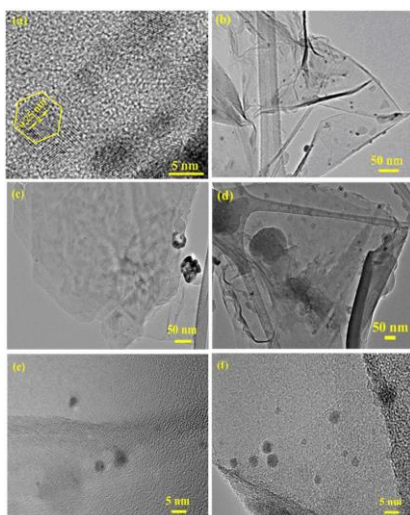


Figure 1: The HRTEM images of (a) AgNPs, (b) RGO/AgNPs, (c, e) GO/AgNPs-(PS-PMMA), and (d, f) R-(GO-(PS-PMMA))/AgNPs nanocomposites

The Small Wonder: Nanoparticles-Based Smart Materials for Therapy & Imaging

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Abstract:

Chemotherapy seeks to minimize tumor progression and increase patient survival. However, the main problem is to find a balance between the drugs therapeutic effect on cancer cells and their deleterious effect on healthy cells. Due to their high hydrophobicity or rather their high hydrophilicity, these molecules must be injected in high and frequent doses, to avoid a rapid elimination and overcome their lack of specificity. Unfortunately, the high chemotherapeutic doses have side effects that patients find difficult to tolerate. Additionally, the diagnosis and imaging of tumor evolution remain a challenge.

In this aim, we developed¹ a theranostic platform consisting of iron oxide ($\gamma\text{-Fe}_2\text{O}_3$) nanoparticles (NPs) coated with water soluble and biocompatible cucurbit[7]uril (CB[7]) macrocycle (Figure 1). The inner cavity of CB[7] is hydrophobic, and allows the encapsulation and the transportation of hydrophobic drugs. Nile Red (NR), a hydrophobic dye, was first loaded into the cavities of the surface-adsorbed CB[7]s, and intracellular delivery of the dye to colon cancer cells was observed by confocal laser scanning microscopy. Powerful anticancer drugs (Paclitaxel, Doxorubicine and Cis-Platine) had been successfully encapsulated improving drastically their solubility. *In vitro* results demonstrate that encapsulation of drugs in the CB[7] cavities on the NP surfaces facilitates the cellular internalization of the drug, thereby enhancing its anti-cancer properties.

Keywords: drug delivery, iron-oxide nanoparticles, cucurbituril, cancer therapy, biomedical applications.

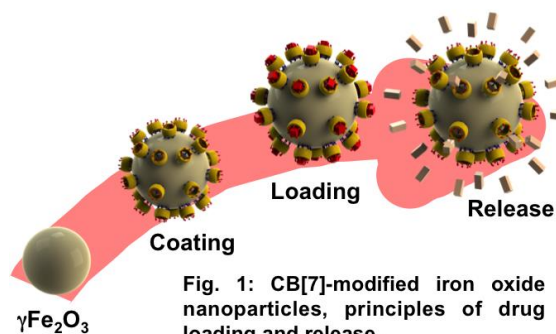


Fig. 1: CB[7]-modified iron oxide nanoparticles, principles of drug loading and release.

Figure 1: Figure illustrating the strategies of surface modification, loading and release mode adopted in this research.

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Fluorescent Carbogenic Nanoparticles

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Abstract: Photoluminescent nano-systems have attracted much attention in last years from both academia and industry. They are widely used in everyday life as well as in highly specialized implementations such as optical analysis, photonics, chemical sensing, molecular tracing and cellular imaging. Recent advances in the field have expanded the library of available fluorescent materials (typically dyes, polymers or proteins) to include semiconductor nanocrystals (so called Quantum Dots) and carbogenic photoluminescent nanostructures (C-Dots). The latter class of materials share properties typical to the metal-containing Quantum Dots, with the advantage of being non toxic and highly biocompatible. C-Dots essentially hold great promise for various biological and biomedical applications. Current research efforts are focused on the development of well defined carbon based nanostructures with tunable size and functionalities and optimum fluorescent capabilities. Up to date, the synthetic strategies have focused on 'top down' and 'bottom down' approaches. The first strategy is based on nano-fragmentation of carbon source while the second one involves mild pyrolysis of organic molecular precursors. Most recently, emphasis is given to explore C-Dot based systems that exhibit dual photoluminescent emission. Those materials can selectively detect the presence of toxic compound even in minute quantities, while showing supreme bioimaging capabilities.

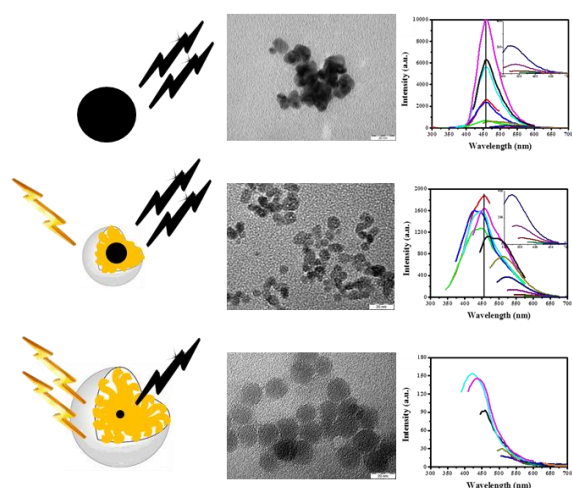


Figure 1: Carbogenic nanoparticles (C-Dots) with dual photoluminescence contribution from both: amorphous nanocarbon and organic dye. The figure illustrates the schematic representation of C-Dots

with dual photoluminescence, the TEM images and PL spectra of aqueous dispersions of those C-Dots.

Keywords: carbogenic nanoparticles, C-Dots, fluorescent nanoparticles, tracers, bioimaging

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Bismuth Sulphide Nanoparticles coated with PVP as contrast agents for X-ray Computed tomography imaging (CT) and effects of different tube potentials.

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Abstract: Nanotechnology has been shown to have enormous potential to enhance the field of radiology by providing an improved medical imaging platform for better diagnosis, improved disease characterisation, and improved monitoring of response to therapy[1]. The incorporation of these materials with medical imaging devices such as CT scans has been demonstrated to overcome many of shortcomings of traditional iodinated contrast media. The optimal nanoparticulate CT contrast medium needs to have a high X-ray attenuation coefficient, low toxicity, a long circulation time, and be cost effective[1, 2]. The purpose of this research is to develop and characterize a Nano-particle and incorporate it into the processes employed by current diagnostic CT imaging devices in order to enhance the device sensitivity and increase the chance of identifying disease at a time when the patient can receive a positive prognosis. This enhancement is also of importance in terms of advancing towards elimination of the need for invasive biopsy, which is the most accurate diagnostic method for cancer detection and therapy follow up. Here we propose the use of bismuth-based nanoparticles that are non-toxic and are one of the least expensive heavy metal-based nanoparticles. In addition, bismuth-based nanoparticles improve x-ray attenuation and hence, they can be used as contrast agents. This research will focus in bismuth sulphide nanoparticles, specifically on their synthesis, characterisation and their cytotoxicity in lung adenocarcinoma epithelial cell line (A549). The nanoparticles and iodinated contrast agents were evaluated for contrast enhancement at various X-ray tube potentials: 80, 100, 120 and 140 kVp. These nanoparticles can be synthesised using a facile strategy for the production of well-dispersed nanoparticles of small size, which are stable in water for a long period of time. This method is based on using bismuth neodecanoate and thioacetamide as bismuth and surfactant sources and oleic acid as a stabilizer[3]. Then these nanoparticles were surface modified with pvp biocompatible polymer. The preliminary results revealed that the high dose of PVP-Bi₂S₃ NPs (13mM) are slightly toxic after incubation time (24 hr) about 80% viability. Furthermore the cells viability was not affected by the nanoparticles up to the dose 6.5mM. CT results revealed that PVP-Bi₂S₃ NPs yielded superior attenuation with CT as the tube potential increases (80 to 140 KVp) when these nanoparticles were compared to iodinated contrast agents.

Key Words: Bi₂S₃ Nanoparticles, Contrast Agents, Iohexol, Computed tomography imaging, PVP, X-ray absorptiometry, polymer.

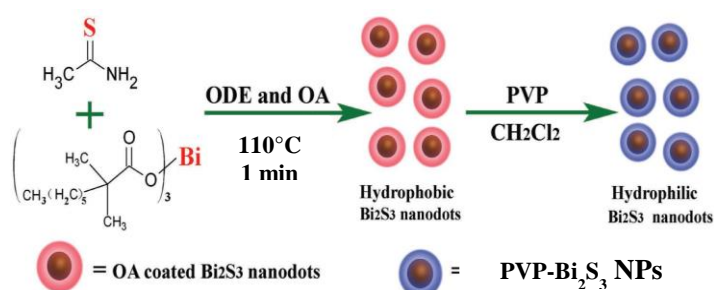


Illustration of synthesis and surface modification of Bi₂S₃ NPs with PVP.

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Sonolytic Synthesis of Bimetallic Magnetic Nanomaterials – Effects Solution Chemistry on Reaction Kinetics

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Abstract:

Fe₂O₃ and CaCO₃ nanomaterials are currently being investigated for nanotherapeutic applications such as medical bioimaging, drug delivery, gene therapy and targeted thermal cancer treatment (Mao *et al.*, 2014; Ma *et al.*, 2013). Sonolytic cavitation of metal-based parent materials has been demonstrated to be an effective synthesis route for the production of nanoparticles and other nanostructured materials (Suslick *et al.*, 2013). Fe-based and alkaline earth metal (Ca- and Mg-based) nanostructured materials were synthesized using ultrasonic irradiation. When specifically considering the application of bimetallic nanomaterials, additional design considerations included the control of relative metal compositions and requirements of production consistency regarding the layering of active metal on the surfaces of the nanomaterials. All materials were characterized using XRD, elemental analysis, HR-SEM and SQUID measurements. Morphology and crystallite sizes were affected by the chemical composition of the synthesis mixture and also upon the sequence of NH₃OH addition to the metal chloride solutions. The majority of interesting structural morphologies were produced in Mg/Ca, Mg/Fe, Mg/Ca mixtures and CaCO₃. Crystallite sizes were estimated using Scherrer analysis to range from 5.92 to 72.13 nm. The effects of solution composition, temperature and pH on the reaction kinetics of sonolytic synthesis and the magnetic properties will also be discussed.

Keywords: Fe₂O₃, Alkaline Earth Metals, Bimetallic, Nanostructured Materials, Sonolytic Synthesis, Ultrasonics, Magnetic Nanomaterials.

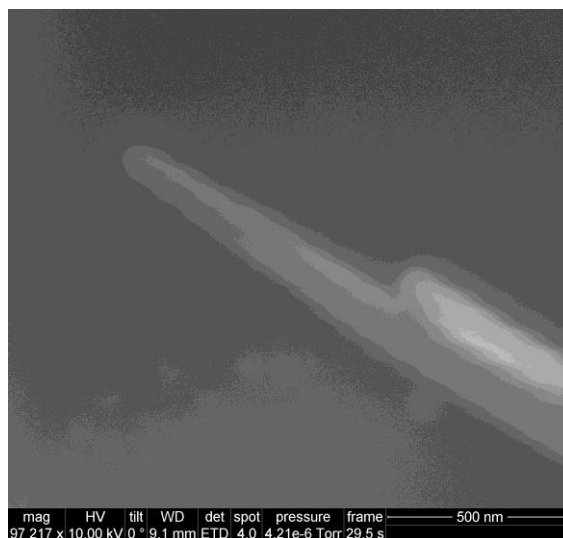


Figure 1: Bimetallic Ca-Mg-Based Nanorod from Sonolytic Synthesis.

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Effect of Solvents on the Dispersion of Graphene Nanoplatelets in Nanohydroxyapatite for Load Bearing Body Implants

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Abstract: Body implants are designed to mimic the properties of human bone and act as a support until the broken or damaged bone is healed (Liebschner, Wettergreen et al. 2003). It is crucial that the engineered substitutes mimic the natural extracellular matrix (ECM) structurally and functionally for a successful regeneration to take place (Tuzlakoglu, Bolgen et al. 2005). Since the properties of the material used to develop the body implant play a major role, we chose hydroxyapatite (HA). HA is the major component of the inorganic segment of our bone, which happens to be a biocompatible material with an excellent osteoconductive properties. Furthermore, HA is a bioceramic material which can easily be synthesised and be used for medical application. However, HA is brittle in nature making it prone to failure due to fatigue which limits its usage in load bearing body implants. To improve this, metals and their alloys, carbon nanotubes as well as polymers have been used and shown positive enhancement (Fan, Wang et al. 2014). In addition, graphene—a single-atom thick sheet of hexagonally arrayed carbon atoms has attracted a tremendous attention due to its high mechanical properties and also biocompatibility. However, homogeneous dispersion of GNP into HA is very difficult since graphene atoms tend to stick together and agglomerate. To overcome this issue, ultrasonication has been used. This research reports the influence of different solvents and sonication time on the dispersion of GNP into HA.

Keywords: load bearing bone implant, biocompatible material, bioceramic, hydroxyapatite, Graphene nanoplatelets, ultrasonication

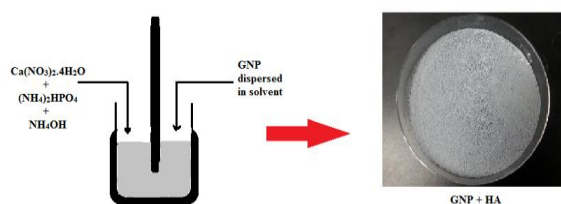


Figure 1: Dispersion of GNP into HA

Figure 1 illustrates the method that is used to synthesise and disperse the GNP into HA. Different solvents such as water, ethanol and acetone were used to disperse the GNP. The synthesised HA/GNP blend was characterized using thermogravimetric analysis (TGA), x-ray diffraction (XRD), scanning electron microscopy (SEM), zeta-sizer, Brunauer-Emmett-Teller (BET), and fourier transform infrared spectroscopy (FTIR). The SEM results show that GNP was homogeneously dispersed into the HA. Moreover, an increase in the thermal stability of the HA in the order of acetone > ethanol > water was depicted by the TGA results. The XRD, FTIR, BET and zeta-sizer results revealed the chemical compositions and particle size of the synthesised HA/GNP blend has the characteristics of HA with smallest nanoparticle obtained in order of acetone < ethanol < water.

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Synthesis and characterization of hydroxyapatite based nanocomposites for structural applications

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Bone is a composite material consisting of hydroxyapatite $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$ [HAp] crystals as a main phase embedded in biologically produced organic matrix. The immune system of the human body exclusively rejects any materials foreign to the body [1]. Synthetic biomaterials need HAp at least in the structure including it to avoid being rejected by living bone. Hydroxyapatite is chemically similar to the mineral component of bones and hard tissues in mammals. It is one of few materials that are classed as bioactive, meaning that it will support bone ingrowths and osseointegration when used in orthopedics, dental and maxillofacial applications. HAp ceramics are reported with osteoconductivity that is being capable of supporting bone apposition and forming a chemical bond with bone [2].

Hydroxyapatite has the ability to integrate in bone structures and support bone ingrowths, without breaking down or dissolving (i.e. it is bioactive). This property of HAp enables it to be used in biological implants [3]. But HAp it does not have the mechanical strength to enable it to succeed in long term load bearing applications. This is why researchers all over the world have been developing methods for improving this property of HAp and hence enabling its usage in structural applications but popularly has been used as bioceramic coatings and as bone filler materials.

Here in this paper we will discuss, how to increase its mechanical property by using nano Titania (TiO_2) as reinforcing material in Hydroxyapatite (HAp) based composite.

Hydroxyapatite (HAp) based nanocomposites were prepared by dispersion of Titania (TiO_2)

nanoparticles using low energy ball milling and were studied in comparison with coarse particle reinforced composites. The Titania (TiO_2) nanoparticle powder was prepared by novel route of mechanical milling at different condition (Dry and Wet Milling) for different time. The Particle obtain and was characterized by using XRD and found that the Dry Mechanical Milling is better than Wet Mechanical milling process in term of Particle size and Hardness, particle size as small as 12 nm was obtain and hence the dry mechanical milling nanoparticle powder was chosen for the experiment. The powders (HAp and TiO_2) were consolidated using microwave sintering and then characterized using XRD, SEM, and TEM. It was found that Titania particles exist in the matrix of crystalline calcium phosphate ($\text{Ca}_2\text{P}_2\text{O}_7$). TEM analysis showed the presence of nanoparticles in the composite powders. SEM showed lower porosities in the nanoparticles reinforced composite when compared with its coarse particle counterpart. Micro hardness analysis showed considerable improvement in hardness of HA when reinforced with nanoparticles of Titania.

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Antifungal volatile compounds encapsulated in nanoparticles

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Abstract: *Botrytis cinerea* is the main phytopathogenic fungus of table grape. It is responsible of gray mould, phenomenon associated with significant economic losses. The control of this pathogen is performed by chemical fungicides, which have diminished its effectiveness due to the emergence of resistant strains and their use is being restricted due to new regulations to agrochemicals. This problem represents a huge challenge for fungicide industry and an opportunity for the development of new technologies in the field of phytopathogens control. In this context, biological control agents arise as an alternative to chemical fungicides due to several mechanisms that these possess to inhibit the growth of fungal pathogens. Among these mechanisms we find production of volatile compounds, molecules that emerge as an interesting option for the development of new fungicides. When *Botrytis* was grown in a medium, which increases the activity of this enzyme, volatile compounds significantly inhibited the growth of this fungus. Therefore, we propose these kinds of enzyme as target for discovery and development of new enzyme inhibitors. Some of the molecules discovered in that project has been demonstrated a potent antifungal effect against *B. cinerea*. However, the application of these kind of volatile molecules is not trivial, usually with low efficiency. Therefore, we propose the use of nano-micro-encapsulation technology for volatile molecules, in order to obtain a product that permit controlled released of this volatile compound. That molecules were encapsulated in different formats of nano- and microparticles and we was able to obtain an encapsulated prototype in a biopolymeric matrix with 10% compounds, which inhibited the growth of *Botrytis* on table grapes for more than 40 days, in storage conditions at 4 °C. Our results demonstrates that antifungal volatile compounds encapsulated in nano- and micro- particles are a powerful tool to control the growth of *Botrytis* on table grapes.

Keywords: antifungal, nanoencapsulation, microencapsulation, biopolymer, *Botrytis cinerea*, grapes.

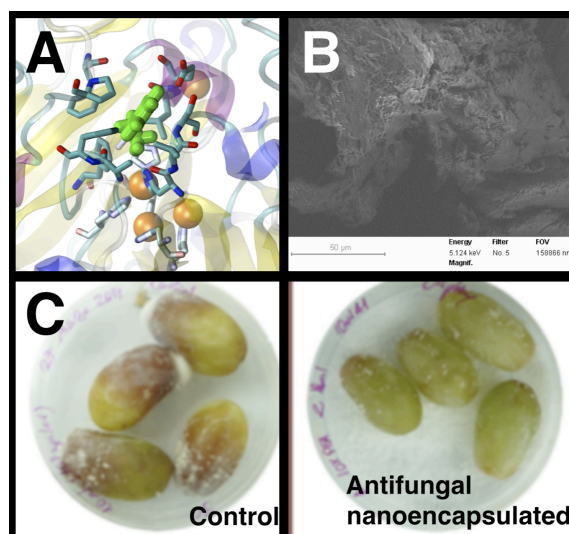


Figure 1: (A) active volatile compound interacting in the active site of lacase enzyme. (B) electron microscopy characterization of nanoparticle, which encapsulate a bioactive volatile compounds. (C) photographe of grapes after 40 days without (control) and with antifungal encapsulated in nanoparticles.

References: PCT/IB2014/063357 WIPO 23.07.2014

Developed and characterization of polymeric nanoparticles based on poly (3-hydroxybutyric acid-co-hydroxyvaleric acid) (PHBV) multifunctionalized with SPIONs, antineoplastic, antibiotics and their applications

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Abstract: Nanotechnology is an alternative drug delivery that promotes improved bioavailability, minimizing the toxic effects by sustained release of the drug and by protecting the active compound degradation by improving their stability over time. This is achieved based on the encapsulation of drugs in biodegradable and biocompatible carriers at nanoscale sizes. Leading to novel strategies for drug delivery and targeting, contrast media for magnetic resonance imaging (MRI), agents for hyperthermia and nanocarriers for antineoplastic and antibiotics. Superparamagnetic iron oxide nanoparticles (SPIONs) are useful for all of these applications, and in drug-release systems, SPIONs allow for the localization, direction and concentration of drugs, providing a broad range of therapeutic applications. In this work, we developed and characterized polymeric nanoparticles based on poly (3-hydroxybutyric acid-co-hydroxyvaleric acid) (PHBV) functionalized with SPIONs and/or the antibiotic and taxol. These nanoparticles can be used in multiple biomedical applications, and the hybrid SPION-ceftiofur nanoparticles (PHBV/SPION/CEF/TAXOL) can serve as a multifunctional platform for the diagnosis and treatment of cancer and its associated bacterial infections.

Results

Morphological examination using transmission electron microscopy (TEM) showed nanoparticles with a spherical shape and a core-shell structure. The particle size was evaluated using dynamic light scattering (DLS), which revealed a diameter of 243.0 ± 17 nm. The efficiency of encapsulation ($45.5 \pm 0.6\%$ w/v) of these polymeric nanoparticles was high, and their components were evaluated using spectroscopy. UV-VIS, FTIR and DSC showed that all of the nanoparticles contained the desired components, and these compounds interacted to form a nanocomposite. Using the agar diffusion method and live/dead bacterial viability assays, we demonstrated that these nanoparticles have antimicrobial properties against *Escherichia coli*, and they retain their magnetic properties as measured using a vibrating sample magnetometer (VSM). Cytotoxicity was assessed in HepG2 cells using live/dead viability assays and MTS, and these

assays showed low cytotoxicity with $IC_{50} > 10$ mg/mL nanoparticles.

Conclusions

Our results indicate that hybrid and multifunctional PHBV/SPION/CEF/TAXOL nanoparticles are suitable as a superparamagnetic drug delivery system that can guide, concentrate and site-specifically release drugs with antibacterial activity.

Keywords: PHBV, SPION, Ceftiofur, Taxol, Polymeric nanoparticles, Drug delivery, Superparamagnetic nanoparticles

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Novel Application of Well-Ordered Mesoporous Silica Nanoparticles as Potent Adsorbent of Phenobarbital

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Abstract:

Recent advancements in morphology control and surface functionalization of mesoporous silica nanoparticles (MSNs) have enhanced the biocompatibility of these materials with high surface areas and pore volumes. Several recent reports have demonstrated that the MSNs can be efficiently internalized by animal and plant cells. The functionalization of MSNs with organic moieties or other nanostructures brings controlled release and molecular recognition capabilities to these mesoporous materials for drug/gene delivery and sensing applications, respectively. In this study we design a synthetic route for synthesis of MCM-41 and amine functionalized mesoporous silica nanoparticles (MCM-41-NH₂). The structure and functionality of these materials were characterized by FT-IR, surface area was calculated by BET method, morphological investigation was done by FE-SEM and TEM, particle size measurement was done by PSA, XRD was also used to determine crystal structure. Novel application of these materials as drug adsorbent was suggested. The efficiency of these materials as adsorbent was tested *in vitro* for phenobarbital. The adsorption isotherms were established and fitting parameters with Langmuir and Freundlich isotherms were calculated.

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Carbon Nanostructures for Electricity Storage Applications

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Abstract: Electricity storage is a growing challenge among a broad range of renewable energy sources. The development of high-energy storage devices has been one of the research areas of top most importance in recent years and rechargeable batteries and/or electrochemical capacitors (supercapacitors) are anticipated to be the primary sources of power for modern-day requirements in portable electronic devices, satellites, and electric vehicles. In the meantime, flexible/stretchable electronics have attracted considerable attention very recent years and have opened the door to many important applications that current, rigid electronics cannot achieve. In order to accommodate these needs, electricity storage devices must be flexible and stretchable in addition to their high energy and power density, light weight, miniaturization in size, and safety requirements. Utilizing nanomaterials and nanostructures such as carbon nanotubes (CNTs) for various electricity storage applications such as electrodes in lithium ion batteries and supercapacitors are under close scrutiny because of the promising electrochemical performance of such nanomaterials. Recently, there has been growing interest in CNT macrostructures, particularly film-like structures because of their unique and usually enhanced properties and tremendous potential for applications in energy conversion and storage. In this presentation, I will report our research efforts on synthesizing 2D CNT macrofilms using chemical vapor deposition method. The CNT films are flexible, machinable and free-standing that could satisfy the needs to develop flexible and even stretchable electricity storage devices.

Keywords: carbon nanostructures, carbon nanotubes, energy storage, lithium-ion batteries, supercapacitors.

Preparation of ZnO doped with CdS nanoparticles for clean, green and sustained power source as solar cell materials

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Abstract: Zinc oxide a unique compound available naturally in earth crust can also be prepared in large quantities from laboratories. They have variety of advantages one among them is their extensive use in sunscreen lotions. By this property they can be a good choice for solar panels.

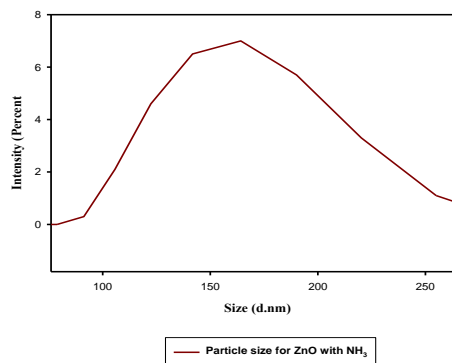
In this work, we synthesized zinc oxide nano particles through co-precipitation process [1,2]. The pH level was maintained at 12 and the precursor used to maintain pH was ammonium nitrate. The temperature was set at 70°C for precipitation. This approach yielded us ZnO (zinc oxide) nano particles of size 170 nm. In parallel to this process CdS (cadmium sulphide) was prepared from cadmium dichloride and thiourea with the same precursor and factors. The obtained nano particles were subjected to sonic agitator for characterization.

Formation of different phases and particle sizes were studied by X-ray Diffraction (XRD), morphology was studied by Scanning Electron Microscope (SEM) and Ultra violet visible spectroscopy (UV-Vis) employed to study the optical and band gap properties. In addition, particle size was confirmed using particle size analyzer.

Our results confirmed that prepared zinc oxide nanoparticles are in the form of wurtzite crystal structure with uniform particle size of 170 nm. We are making the solar panel out of our synthesized samples. We plan to coat a thin layer and study the effect of thickness on the solar cell properties.

Keywords: ZnO, CdS, co-precipitation, solar cells.

Fig 1: The particle synthesized is of 170 nm, which also shows prepared sample is actually ZnO nano particles.



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The Design and Investigation of a Novel Nano Dye Sensitized Solar Cell (DSSC) with Utilizing Coating Paints on Porous Surface to Promote Energy Efficiency

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Abstract:

Manufacturing of Dye-sensitized solar cells (DSSC) compounds among the other solar cells is simple and because of its low-cost production, they are offering devices for the large-scale and inexpensive conversion of the solar energy. However, the conversion efficiency relatively low and needs an intensive research work to improve it. The upside of this sort of cells is that different materials can be utilized for sensitive parts of the device. The purpose of this research is evaluation component of the energy efficiency of light-sensitized solar cells based on porous silica. Unique properties of porous silica substrate, such as high surface area, mechanical and thermal stability, volume and diameter of the high risk makes to the solar colors (Dye Solar) Cells of this type of structure used effectively in the context of crystalline silica dispersed porous and due to this type of bed volume with a specific morphology, which would increase the efficiency. The solar colors (Dye solar) based on a porous substrate are observed and detected by XRD and XRF techniques and also the tin oxide coating on a porous silica substrate has been studied by techniques of SEM. On the other side, the efficiency of solar energy components factors such as type, color and, temperature, surface area, the coating were examined and appropriate amounts in each case was optimized. In this investigation, nano blocking layer of Titanium dioxide and Tin dioxide with applying spray pyrolysis depositionin (SPD) was coated on this dye sensitized solar cell

Keywords: Dye Solar, photo voltaic cells, Nano Layer, spray pyrolysis depositionin (SPD), Paint, porous substrates, color conversion coating, DSSC.



Figure 1: The picture of some of the manufactured dye sensitized solar cell (DSSC) in this study.

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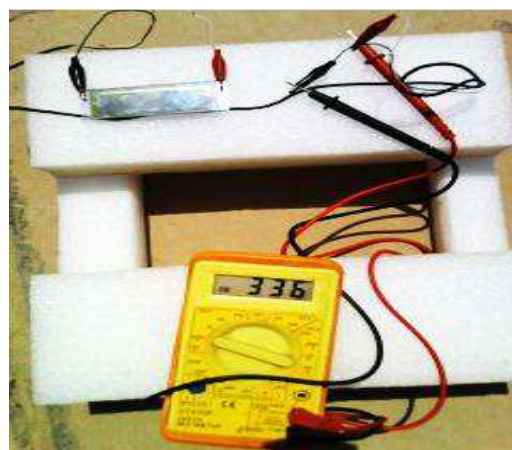
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Preparation and Fabrication of Quantum Dot-Sensitized Solar Cells (QDSSC) with CdS Quantum Dots a prepared by an ultrasonic-assisted chemical bath deposition method

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Abstract: Quantum dot sensitized solar cells (QDSSCs) are a promising low cost option to existing PV technologies such as crystalline silicon (silicon) and thin inorganic films. A QDSSC make use of Quantum Dots (QDs) as light absorbing material (Lai *et al.*; 2014, Mohammad; 2013, Jun *et al.*; 2013, Daniel *et al.*; 2012). In this study, we have been manufacturing one of the important hybrid solar cells that operate on quantum dots light-sensitive instead of organic dyes sensitive to light for more stability and withstand climatic conditions, using a Spray Pyrolysis Equipment technique. The film FTO has been manufactured from doped tin oxide by fluorine ($\text{NH}_4\text{F}:\text{SnCl}_4 = 15\%$) and spraying the solution along the hot glass slide at $450\text{ }^\circ\text{C}$, the surface resistance of the film up to ($10\ \Omega/\square$), the thickness of the film 24 nm, transparent of the film 87%. The photoelectrode for cell (the anode) has been constructed through the coating of conductive FTO layer of porous material of nano titanium dioxide (paste), which was prepared by means of sol- gel method, the particle size up to 30 nm and absorbance of 1.49 nm at the wavelength ($\lambda_{\text{max}} = 344\text{ nm}$). CdS quantum dots have been fixed by using (Sol- Gel) route and stick to using the ultrasonication technique to down to quantum dot particle size to 6-10 nm, absorbance 1.5 nm at the wavelength ($\lambda_{\text{max}} = 420\text{ nm}$), were deposited onto a TiO_2 nanoparticles surface using an ultrasonic-assisted chemical bath deposition method. To make the counter electrode (the cathode) has been coating another glass FTO by using of active layer from the carbon catalyst. The solar cell (Figure 1) parameters are short circuit photocurrent (I_{SC}), open circuit photovoltage (V_{OC}), Fill Factor (FF) and conversion efficiency college (η), was ($110\ \mu\text{A}$), (266 mV), (25%) and (1.2%) for an AM 1.5 irradiation ($100\text{ mW}/\text{cm}^2$), respectively.

Keywords: Nano materials, QDSSC, Quantum dots, Electrolytes, sol-gel, FTO thin films, AFM. XRD.



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Figure 2: Scheme of the QDSSC :

Utilization of Waste Cooking Oils for Biodiesel Production using Nanocatalysts

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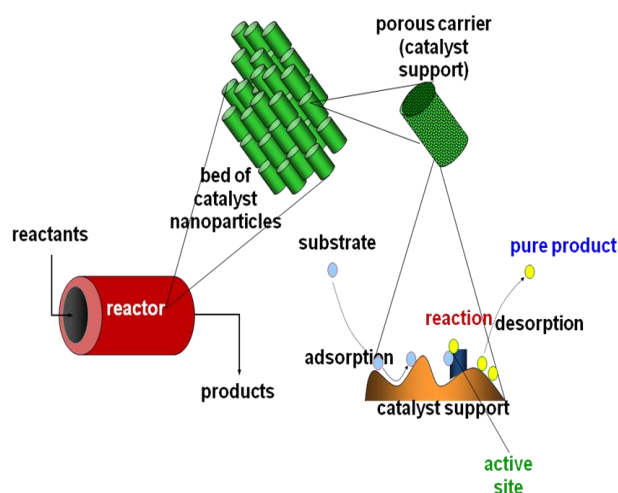
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Abstract: Biodiesel production from different vegetable sources is worthy of continued study due to its renewable and biodegradability nature. The lack of feedstock availability, high feedstock cost, high catalyst cost, and also, the low products quality resist the success of biodiesel manufacturing project (Abo El-Anin *et al.*, 2013). Inexpensive bio-diesel production can be performed via trans-esterification of Waste Cooking oils (WCO) using Nanoparticles of Cement dust as heterogeneous catalyst. Catalytic processes are increasingly applied in biofuel development. The free fatty acid (FFA) content of the feedstock oil is not an important consideration in case of using heterogeneous catalysts (Bojan *et al.*, 2012). In this paper, the engineering factors affecting the synthesis process of fatty acid methyl-esters in batch reactor have been optimized using Factorial Design of experiments; since currently, experimental design became a tool for better understanding of the process and to evaluate the interactions among the operating variables than the unplanned approach. Also effect of catalyst deactivation on the biodiesel yield was investigated (Figure 1). In addition, we will introduce new challenges of using this type of nanoparticles in reducing the cost of biodiesel production. The study will also permit us to discuss the improvement of process products quality, biodiesel and glycerol using phosphoric acid; since nanocatalysts play an important role in improving product quality and achieving optimal operating conditions (Akia *et al.*, 2014). Finally, properties of the produced biofuel were tested according to the EN 14214 standards.

Keywords: biodiesel, trans-esterification, waste cooking oils, nanoparticles, heterogeneous catalysts, methyl-esters, catalyst deactivation.

Figure 1: Figure illustrating the fundamental question that we are tempting to solve experimentally: what is the importance of using nanocatalysts in biodiesel manufacturing, how are nanocatalysts

affecting on the product quality, how are the engineering parameters (catalyst size, catalyst loading and react-



ion temperature) affecting on the biodiesel yield, and how can improve the product quality?

References:

Abo El-Enin, S., Attia, N., El-Ibiari, N., El-Diwani, G., El-Khatib, K. (2013) In-situ transesterification of rapeseed and cost indicators for biodiesel production, *Renewable and Sustainable Energy Reviews*, 18, 471-477.

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Carbon-Nano-Tube (CNT) from Carbon Rich Fly Ash: its production and expected futuristic trend

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Abstract

Carbon Nano-Tube (CNT) is being used in many applications in order to enhance their durability and performance. Several improvements have been introduced in many applications with the help of CNT and significant developments are to be made in this field so as to ensure sustainable quality of life.

The aim of this paper is to emphasize on the current as well as future trends of CNT produced from carbon rich fly ash. The paper will make use of different authentic sources so as to carry out effective research on the topic. Significance of CNT in GCC countries will also be highlighted.

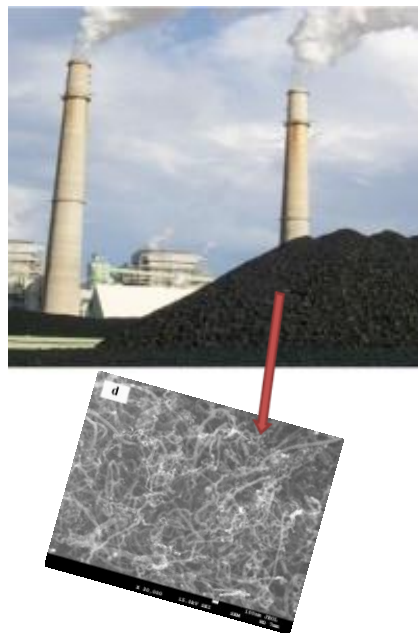
Fly Ash is the largest type of waste generated in Saudi Arabia and in many other countries. For example, in United State over 100 million tons produced every year. Crude oil fly ash (which is available in Saudi Arabia in huge quantities) is found to have high amount of pure carbon. Many factories in Saudi Arabia produce Carbon-Rich Fly Ash (Cements, Electricity plants, material factories, desalination plants, petrochemical industries). The large quantities of fly ash is produced from desalination Plants (total 30 PLANTS in Saudi Arabia). These DPs produce drinking water and electricity. USA 10 times production of Carbon rich fly Ash. China and India may be less because they are mostly using Coal as a fuel. In Saudi Arabia Desalination Plants, produce Carbon Rich Fly Ash. Pure carbon contents exceeded 85% of the total fly ash components.

Therefore, this work is designed to utilize carbon rich fly ash of crude oil for CNTs production.

This new approach for producing CNTs in a large scale is by utilizing carbon-rich fly ash using a low-pressure chemical vapor deposition (LPCVD) system. Carbon nanotubes (CNTs) have unique properties and therefore, attracted great attention for using them in a wide range of applications.

However, with the existing raw materials they are still very costly. In particular, cost of the catalysts and precursors for CNTs growth are very high. This has limits CNTs production in a large scale.

The method of forming carbon nanotubes from carbon-rich fly ash is a CVD-based method and the technique will be explain. The report will assist in determining current applications of CNT in different applications as well as its future use



Keywords

Nanotechnology, Nanomaterials, CNT, Fly Ash , CVD

Utilization of Waste Cooking Oils for Biodiesel Production using Nanocatalysts

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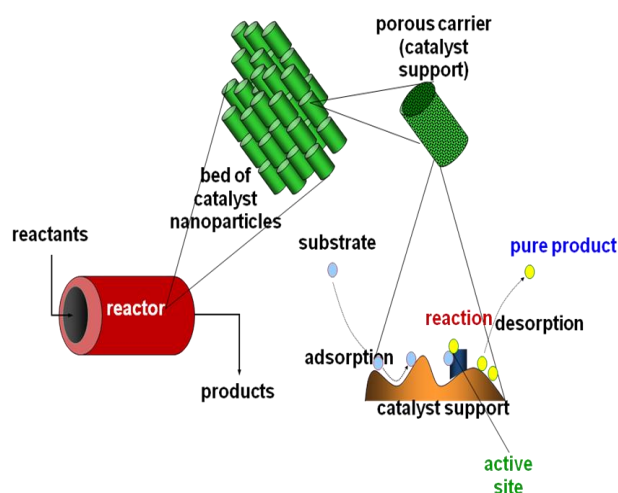
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Synthesis of Iron Oxide Doped Zeolite – An Antimicrobial Nanomaterial for Drinking Water Purification Applications

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Abstract: Clean water, a prerequisite for safe and healthy life, is continuously facing a decline in its quality due to rapid industrialization, urbanization and population growth (Reimann *et al.*; 2004). The major issue that is in concern now a days, in both developed and under-developed countries, is the presence of waterborne pathogens that are becoming resistant to the already known methods of their removal and are now able to cause severe infections and with much less number (Reynolds *et al.*, 2008). Hence, the conventional methods of treatment [Reynolds *et al.*, 2008; Velusamy *et al.*, 2010] have no longer remained effective. Further, there is a need to develop those methods and materials that lead to disinfection without resulting in formation of harmful contaminants (Li *et al.*, 2008). Therefore, owing to these reasons, strive to develop new methods had led researchers to focus their attention to nanotechnology (Li *et al.*, 2008).

In this regard many nanomaterials were used like Ag (0), TiO₂, ZnO etc. and found effective in treatment of waterborne microbes. In case of TiO₂, the UV light irradiation is must to induce its photocatalytic properties and also against *E. coli* lower doses are not found effective (Maness *et al.*, 1999) and higher doses are nor safe to use. The bactericidal (bacteria-killing) and bacteriostatic (bacteria-inhibiting) nature of the nanoparticles was attributed to microbial cell wall disruption that can either be caused by direct contact between the nanoparticles or due to formation of reactive oxygen species by the nanoparticles which on interaction with microbial cell wall led to death of microbes (Li *et al.*, 2008); in certain cases change in morphology of the treated cells was also observed (Xie *et al.*, 2011).

In order to treat the issues associated with drinking water contamination, the present research was designed to develop low cost filter based on iron doped zeolite (Fe-Z) and pottery clay for an effective and efficient treatment of the drinking water contaminated with microbes. Fe-Z was characterized using powder XRD, SEM and EDX and shown to have average particle size of 49nm with spongy appearance. The simulated samples of water self-contaminated with six microbes (*S. typhi*, *B. subtilis*, *E. coli*, *S. aureus*, *K. pneumoniae* and *P. aeruginosa*) after treatment

with Fe-Z indicated effective removal of all the microbes in less than 30min. Equally good results were obtained when actual drinking water samples, totally unfit for human consumption, were treated with Fe-Z.

Keywords: Iron doped zeolite, biological and chemical treatment, drinking water.

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Photocatalytic ozonation of bromide containing waste water: related problems and kinetic based strategy evaluation

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Abstract: In the so-called Photocatalytic Ozonation (PO) synergistic effects between photocatalysis and ozonation enhance the rate of oxidation of organic compounds, so that this integrated process is very promising for practical applications in water treatment (Augugliaro *et al.*, 2006). However, advanced oxidation processes (AOPs) applied to waters contaminated by organic pollutants and containing also innocuous bromide ions may generate bromate ions as a co-product. The International Agency for the Research on Cancer classifies bromate as a potentially carcinogenic species and the bromate formation during AOPs of water containing bromide is being deeply studied. In the present work heterogeneous photocatalysis and ozonation have individually been applied and in combination (integrated process) to degrade the organic compounds in water containing also bromide anions. Results show that: i) the sole photocatalysis does not produce bromate ions and in the case of its presence, it is able to reduce bromate to innocuous bromide ions; ii) the integration of photocatalysis and ozonation synergistically enhances the oxidation capabilities; and iii) in the integrated process bromate ions are not produced as long as some oxidizable organics are present (Parrino *et al.*, 2014). It is also demonstrated that the improvement that can be obtained by the integrated process in comparison with the uncoupled processes depends on the relative weight between photocatalysis and ozonation. In this respect, it has been found that a relatively low rate of photocatalysis (0.3 times the rate of ozonation) is sufficient to get the highest synergy and to maximize the performances. The benefits of the coupling of photocatalysis to ozonation are not limited to the increase of the oxidation rate, but include also the control of the ozonation by-product of main concern (bromate). The effect of pH, presence of oxidizable organic compounds, presence of nitrogen on the formation or on the reduction of bromate are experimentally identified and then discussed. The obtained results have relevance for the practical application of PO, since on these bases it is possible to identify proper operative conditions.

Keywords: Photocatalytic ozonation, bromate, water purification, ozonation, photocatalysis, advanced oxidation processes, process intensification.

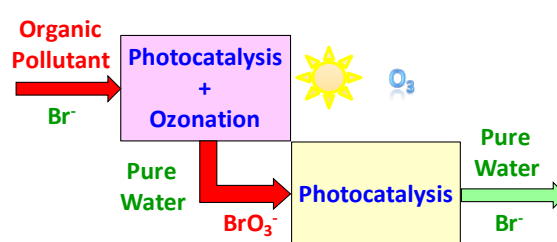


Figure 1: Schematic representation of a possible strategy to mediate between water purification targets and control of bromate ions concentration.

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Fabrication and characterization of ZnO nanoparticles by thermal decomposition of Zinc picolinate and Zinc citrate dihydrate

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Abstract:

Zinc Oxide (ZnO) is an II–VI semiconducting material with excellent optical, piezoelectric, pyroelectric, and photoconducting properties. ZnO nanoparticles and nanostructures in the hexagonal wurtzite structure are used in a wide range of important technological applications including optoelectronic sensors, actuators etc. ZnO nanoparticles have been synthesized by several methods such as chemical vapour deposition, thermal decomposition, hydrothermal method, and chemical synthesis [1]. In the present work, nanoparticles of ZnO were produced by the thermal decomposition of Zinc picolinate and Zinc citrate dihydrate. Zinc picolinate is formed by the chelation of Zinc with picolinic acid, a pyridine containing compound with carboxyl side chains and Zinc citrate is the zinc salt of citric acid, a compound with three carboxyl groups. Zinc picolinate and Zinc citrate were of analytical grade and purchased from Fluka and Aldrich respectively. The dry powders were placed in porcelain crucibles and heated at 500 and 650 °C for 6 hrs with a heating rate of 10 °C/min. The morphology of the products was examined with scanning electron microscopy (Zeiss SUPRA 35VP). Thermogravimetric (TGA) profiles were recorded on a TA Q500 instrument at a heating rate of 10 °C/min in flowing air (60 ml/min). The UV/Vis spectra of the prepared powders were measured by using a Perkin Elmer Lambda 35 spectrophotometer equipped with RSA-PE-20 integrating sphere and Photoluminescence (PL) emission spectra were acquired with the aid of a luminescence spectrometer (Hitachi F2500) with excitation at 325 nm using a Xe lamp. XRD patterns revealed that ZnO crystallites had the hexagonal wurtzite structure. TGA curves illustrated that decomposition is completed at 430 °C and 500°C for Zinc citrate and Zinc picolinate respectively. The optical band gap of ZnO nanoparticles was calculated by Tauc's plot method and was ranged from 3.03 to 3.11 eV. The PL spectra of ZnO prepared from Zinc citrate dehydrate showed strong excitonic UV emission at 398 while in the case of Zinc picolinate the peak appears at 377 nm. All PL spectra showed a broad blue-green emission band at around 500 to 600 nm due to different intrinsic defects [2]. Figure 1 depicts SEM images of ZnO nanoparticles obtained by thermal decomposition. All the samples consisted mostly from nearly spherical nanoparticles in the range 50-180 nm while increase of

temperature from 500 to 650 °C resulted in an increase of particle size.

Keywords: Zinc Oxide, semiconductors, Zinc picolinate, Zinc citrate, thermal decomposition.

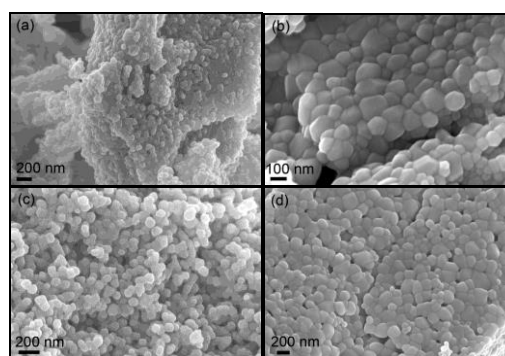


Figure 1: SEM images of ZnO nanoparticles obtained from thermal decomposition of Zinc citrate (a,b) and Zinc picolinate (c,d) at 500 °C (a,c) and 650 °C (b,d).

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Wearable Interactive Electronics for Smart Living and Sustainable Future

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Abstract: We report on heterogeneous electronic materials and high-performance complementary metal oxide semiconductor (CMOS) based tunable shape-size-conformity wearable interactive electronics and systems for smart living (computation-communication-infotainment) through internet of everything and a sustainable future (healthcare-water-food-environment-security). For scientific exploration, we make collective use of the materials, processes and device architecture leveraging multidisciplinary tracks of material science, bioengineering, mechanical, environmental engineering and computer science. As engineering tool, we use CMOS technology extensively due to its industrial relevance, maturity and reliability for rapid tech transfer.

Thin film based inorganic electronics dominate nearly all areas of electronics: logic, memory, display, power devices, medical electronics, micro/nanoelectromechanical systems (M/NEMS), energy devices, analog devices and in automobile electronics. Examples include but not limited to silicon, silicon germanium, gallium nitride, indium phosphide, silicon carbide, etc. Ninety percent of the digital electronics are made with bulk mono-crystalline silicon (100). Although these electronics show extraordinary performance (processing speed), power savings (energy efficiency), multi-functionality (due to ultra-large-scale-integration density) and cost-savings (due to batch processing using CMOS technology), they are rigid and brittle. Therefore, our approach is to transform such electronics into flexible-stretchable-reconfigurable one while retaining their inherent advantages and constantly integrate them with upcoming active materials (0D, 1D, 2D, organic) in an opportunistic way to open up new horizons for electronics and information technology. In the past, transfer printing, spalling, back grinding have been used to make ultra-thin inorganic electronics based flexible and stretchable electronics but often they lack in competitive charge transport (due to usage of unconventional silicon (111) with many defect dislocations), expense (expensive silicon-on-insulator or ultra-thin silicon substrate, low throughput epitaxy, expensive high energy ion implantation, device damage during back grinding or spalling, complete wastage of wafer, etc.), and compromise in integration density (specially through transfer printing of small devices). To address them, we have developed CMOS processes based new technologies and applications opening up multiple fronts in science and engineering. One key question is: when the

ICs are so tiny why do we need to make them flexible? In reality the most powerful ICs like microprocessors for computers or cell phones are not small ($> 1 \text{ cm}^2$). Specially for implantation on soft tissue or organs and on asymmetric curvilinear surface we need multi-functional high-performance ICs like them and thus flexing them is critical. In that regard, in my keynote speech I will detail two of our major efforts:

1. Layered Ultra-thin Inorganic Film Based Flexible Electronics [1, 2]
2. Stretchable Inorganic Thin Film Fabric [3, 4]

As examples, I will use state-of-the-art sub-20 nm FinFET CMOS with advanced high- κ /metal gate stack and smart thermal patch to demonstrate the effectiveness of the developed processes.

Keywords: ultra-thin electronics, flexible electronics, stretchable electronics, FinFET, advanced healthcare.

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Design of plasmonic structures using capillary force assembly

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Abstract:

Metallic nanoparticles show remarkable plasmonic properties. Especially, they have the capabilities to resonantly scatter or absorb the light and to locally enhance the electromagnetic (EM) field. Thus, they are particularly adapted for a wide range of applications like as ultrasensitive detector or localized therapy tool for healthcare. However getting the quintessence of plasmonics requires a fine adjustment of the nanostructure's shape and placement. Capillary force assembly (CFA) has proven to be one of the most promising techniques to create shape controlled plasmonic nanostructures from metallic colloids [1-2].

In this work, we show that convective-assisted CFA on patterned substrates (fig. 1) can be used to position in a deterministic way particles in solution independently of their size, shape or nature. Next, as a first example of the interest of the technique in the field of plasmonics, we present the optical properties of fabricated Au dimers with controlled gap. Plasmonic coupling [3] in single dimers is observed (fig. 2a). The resulting EM enhancement is experimentally observed through photoluminescence amplification on quantum-dot-decorated dimers. Finally, as a second example, unique optical behaviour [4] of 3D Au nano-clusters is discussed. Especially, collective propagation modes are revealed from two-photon luminescence (TPL) measurements (fig. 2b).

Keywords: Plasmonics, Gold nanoparticles, Self-assembly

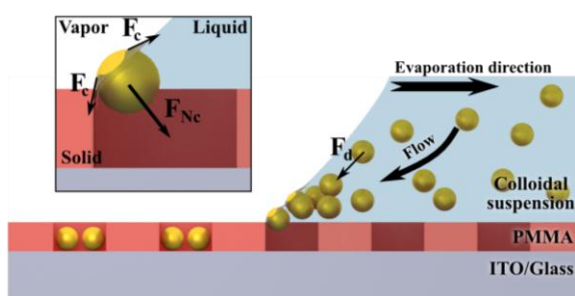


Figure 1: Capillary Force Assembly (CFA) principle.

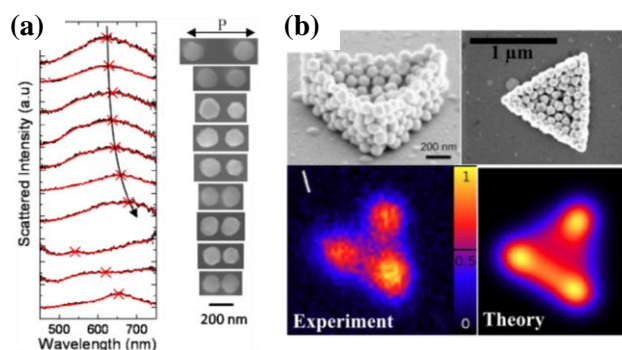


Figure 2: (a) Scattering spectra of single dimers with decreasing gap and corresponding SEM images. (b) Images of a 3D triangular cluster and its experimental and theoretical TPL intensity map.

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Torsional Resonators Under Mixed-frequency Excitation for Improved Bandwidth

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Abstract: The interesting dynamical behavior of Micro resonators when excited by mixed-frequency excitation has sparked significant interest in the MEMS community due to their potential in the areas of communications [1], logic functions [2], and atomic force microscopy [3]. Mixing of frequencies through quadratic electrostatic forces has been proposed in [1,4] to realize down converters, mixers, and filters. Comprehensive study on the dynamical behavior of resonators under mixed-frequency excitation has not been presented so far, unlike the case of a single source excitation that has been studied thoroughly [5]. The full potential and use of mixed-frequency excitation and its exploitation for practical MEMS applications has not yet been explored in depth, especially for torsional actuators and micro-mirrors.

This work presents, for the first time a simple method to broaden the bandwidth of resonators without introducing any complexity in the design or fabrication. By implementing a mixed-frequency actuation composed of two or more AC harmonic loads and through proper tuning of the AC frequencies, significant amplification in the frequency band of large response is achieved. When a resonator is excited with two harmonic sources of frequencies Ω_1, Ω_2 , two new resonances appear at $\Omega_1 + \Omega_2$ (additive) and $\Omega_1 - \Omega_2$ (subtractive) apart from the primary resonance, which are called combination resonances [6]. In this work, we exploit the additive and subtractive resonances to broaden the bandwidth of the resonator. By choosing one of the excitation frequencies to be fixed at a small value, the combination resonances become very close to the primary resonance, thereby, forming a continuous band of large response at an extended frequency range. Theoretical and experimental results are presented for a case study of a polyimide micro-mirror. The results show that these resonances can be activated at any chosen frequency with the desired amplitude by a proper choice of the input AC voltages and their frequencies. The ability to generate multiple resonance peaks at desired frequencies and control their amplitude without complicating the device layout is very promising feature that can be widely used in many MEMS applications, such as resonant sensors, energy harvesters, MEMS gyroscopes, and other applications.

Keywords: Micro Mirror, Mixed-frequency excitation, Multi-frequency excitation, Resonators, Electrostatic actuation, Polyimide, Band width

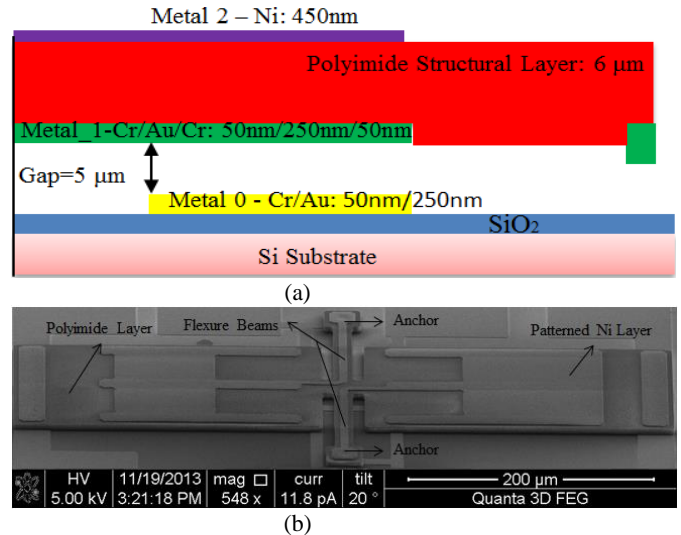


Figure 1: (a) Fabrication cross section of the right half of the micro mirror. (b) An SEM image of the micro mirror.

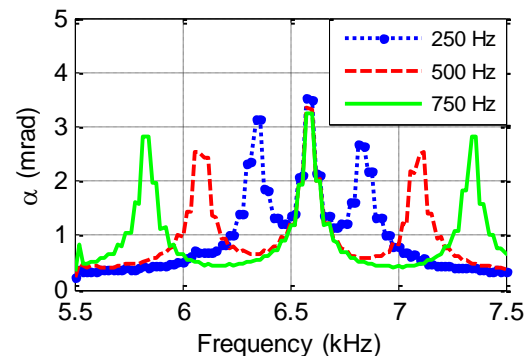


Figure 2: The broadening of the bandwidth using mixed-frequency excitation. Three different fixed frequencies are used, and it can be noticed that apart from the natural frequency at 6.6 kHz, additive and subtractive resonances appear for each case resulting in the broadening of the bandwidth.

References:

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Higher Order Modes Excitation of Micro Clamped-Clamped Beams

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Abstract: MEMS resonator's such as micro-plate and micro beams are the main building block of many MEMS sensors and actuators that are used in variety of application such as toxic gas sensors, mass and biological sensors (Subhashini *et al*, 2012). Exciting the micro structure near its higher order modes improves the sensitivity and quality factor of the resonator which implies a sharper response curve with higher amplitude (Jin *et al*, 2006).

In this study, we present analytical and experimental investigation of electrically actuated clamped-clamped based resonators. The objective is to excite the higher order modes of the micro structure using partial electrodes with shapes that resemble the shape of the mode of interest (Okada *et al*, 2009). These devices are fabricated using polyimide as a structural layer coated with Nickel from top and Chrome and Gold layers from bottom. Using the micro system analyzer (MSA), the microstructure dimensions and the gap thickness are measured experimentally. Then, a noise signal applied to experimentally reveal the first three resonance frequencies. Also, we studied the nonlinear dynamics of the micro structure near these resonance frequencies by applying forward and backward frequency sweeps with different electro dynamical loading conditions. Then, the effect of changing the DC loading on the first resonance frequency value is investigated. In addition, the micro-structure stiffness is experimentally extracted by applying different DC voltages and measuring the static deflection of the microstructure. The results prove the ability to excite higher order modes effectively using partial electrodes. Using a half electrode, the second mode is excited with high amplitude compared with no response using the full electrode. Also, using the two-third electrode increases the third mode resonance amplitude compared with the full electrode under the same electrical loading conditions. Such micro-resonator is shown to be promising in gas and mass detection applications.

Keywords: resonators, partial electrodes, higher order modes, electrostatic application, mass sensing applications.

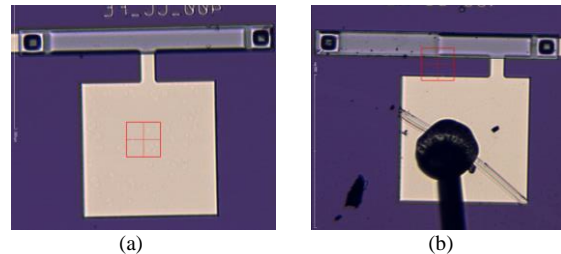


Figure 1: (a) Top view of clamped-clamped beam with full electrode to excite the first mode. (b) Top view of clamped-clamped beam with half electrode to excite the second mode.

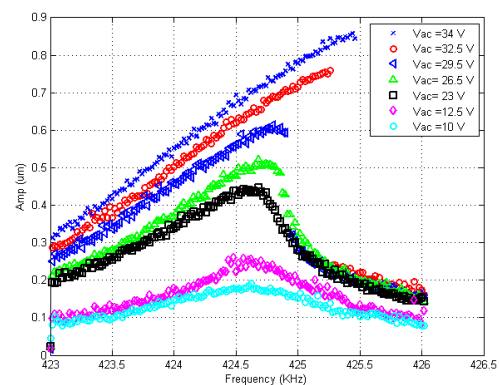


Figure 2: experimental result proves the ability to excite the second mode using a half electrode at $V_{dc} = 5$ v and V_{ac} as shown.

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Oxide Ion Conduction in La²⁺ and Sr²⁺ Co-Doped Ceria/(Li-Na)₂CO₃ Multifunctional Nanocomposite electrolyte for LT-SOFCs

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Abstract

Nanocomposite electrolyte in the system Ce_{0.85}La_{0.125}Sr_{0.025}O_{1.9125}/(Li-Na)₂CO₃ has been synthesized by mixing nanosized co-doped ceria powder prepared by citrate-nitrate gel auto-combustion method with eutectic mixture of lithium and sodium carbonates. Synthesized powder has been characterized via TGA/DTA, XRD, SEM, thermal expansion and impedance spectroscopy. Single phase formation has been confirmed by XRD. XRD data suggest that carbonates exist as an amorphous phase. SEM micrograph shows a percolated network of ceria and carbonates in which carbonates covers the surface of ceria particle. Complex plane impedance spectra have been recorded. The main feature of the impedance spectra is the absence of distinct grain boundary arc in contrast to the doped ceria electrolytes where distinct grain and grain boundary arcs have been observed. Conductivity increases very rapidly around the melting temperature of the carbonates due to superionic transition at the interfaces formed between the ceria and carbonate phases. This has been interpreted due to formation of space charge layer at the interfaces. Space charge layer consists of large number of mobile defects than

that of the bulk. Conductivity of 0.12 S/cm has been observed at 500 °C with an activation energy 0.50 eV of conduction.

Keywords: Co-doped ceria; Nanocomposite; Electrical conductivity; LT-SOFC.

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Preparing transperence conductive glass by using APCVD system

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Abstract

In this research tin oxide doped with Indium (SnO₂:In) was prepared by using a chemical vapor deposition method under normal atmospheric pressure APCVD. Several films were prepared by using different ratios of indium (Sn: In = 1: 0.1, 1: 0.3, 1: 0.6, 1: 0.8) at glass substrate temperature (450⁰ C) and the flow of gas (1.5 L / M) and a time of 10 minutes and using tin chloride (SnCl₂: 5H₂O) purity of 99.98% as starting material. The survey was conducted using an X-ray diffraction (XRD) were, also the surface morphology by using atomic force microscope (AFM). Optical properties have been studied by using UV-Vis spectroscopy. Electric properties studied by (Van Der Pauw) principle. through spectroscopic study of these films was found to have a high transmittance in the visible region from the spectrum and high reflectivity to the infrared region, which qualifies it for use as Anti-reflection coating in same time very low resistivity (2.07*10⁻⁷ Ω.cm)..

Keywords: SnO₂, thin films, APCVD, conductive glass.

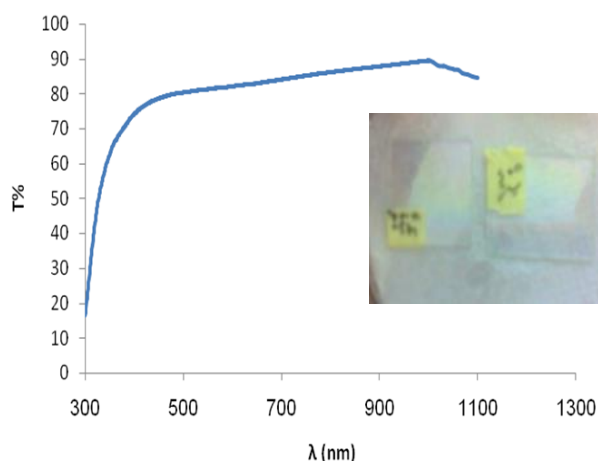


Figure 1: Figure illustrating the transmittance of SnO₂ thin film at glass substrate temperature (450⁰ C) .

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Poster Presentations

Synthesis of transition metal oxide core-shell and composite nanoparticles and their magnetic properties

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Abstract: We have investigated the synthesis of core-shell and composite transition metal oxide nanoparticles. The particles were synthesized by thermal decomposition of metallorganic precursors in a high boiling solvent at 300°C. We synthesized particles consisting of a mixture of iron oxide and manganese oxide in a two-step process.

In the first step, iron oleate and manganese oleate, respectively, were used as precursors for the production of pure iron oxide and pure manganese oxide nanoparticles. By varying the reaction parameters or using specific additives, the size and shape of the particles could be controlled, in particular it is possible to create spherical or cubic particles. In the second step, these particles were used as seed particles to grow nanocomposites. Applying different reaction parameters, we were able to synthesize composite as well as core-shell particles. The particles were characterized by transmission electron microscopy (TEM), using the energy filtered imaging mode (EFTEM) to visualize the qualitative elemental distribution with a resolution in the nm range. Typical particles in the size range of 15-20nm are presented in fig. 1. The elemental distribution from the EFTEM measurement reveals the core-shell structure as shown in fig. 2. Discussing the results, in particular, the role of the oleic acid concentration on the growth process of the particles is addressed.

The magnetic properties of the particles were studied by magnetization measurements. Field cooled magnetization measurements on composite particles reveal hysteresis with a shift of the hysteresis curve (exchange bias) of about 700 Oe. We suggest that this exchange bias arises at the interface between the antiferromagnetic manganese oxide and ferrimagnetic iron oxide part within the composite particles.

The preparation method for composite nanoparticles described here is widely applicable, e.g. it can be applied to almost all transition metal oxides. Besides the iron oxide/manganese oxide system, we also applied the method to iron oxide/cobalt oxide particles.

Keywords: core shell, nanoparticles, transition metal oxide, iron oxide, manganese oxide, cobalt oxide, magnetic properties, exchange bias

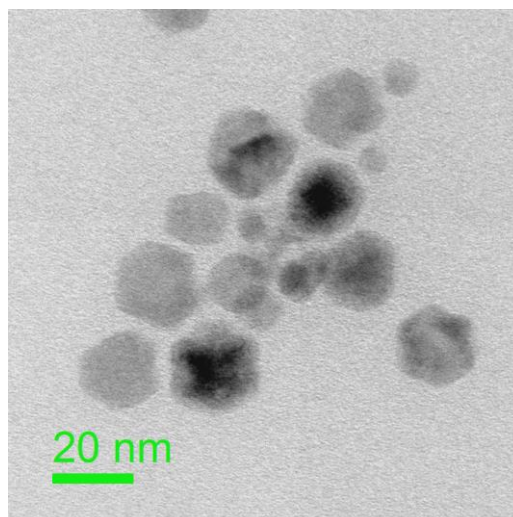


Figure 1: TEM micrograph of core/shell nanoparticles composed of iron oxide and manganese oxide

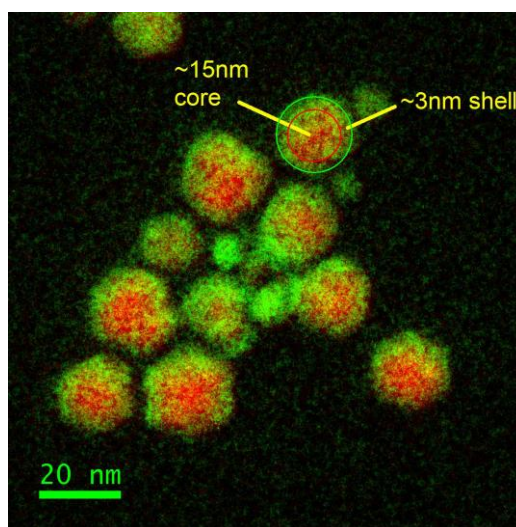


Figure 2: Energy filtered image revealing the distribution of iron and manganese within the particles. The core consists of manganese oxide (red), surrounded by a shell of iron oxide (green).

Reference:

Ullrich, A., Hohenberger, S., Oezden, A. and Horn, S. (2014) Synthesis of iron oxide/manganese oxide composite particles and their magnetic properties. *J. Nanopart. Res.* 16, 2580.

Novel Strategy to Produce Hollow Half-Nanosphere Arrays

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Abstract: Given the unique characteristics of hollow structures, spanning high specific surfaces, low volumetric density values, and low refractive indices, hollow structures have attracted broad interest for a wide range of applications, including photonics and optoelectronics,¹ surface catalysis,² and transparent nanostructured coatings (e.g., superhydrophobic, anti-fouling).³ However, to date, there are only limited ways of preparing asymmetrical hollow structures in micro/nanoscale size range.⁴ In recent work, we developed a novel strategy to produce hollow half-nanosphere structure on various glass substrates. In our method, liquid droplets condensed on the substrate are used as “instant” template. By forming a thin layer of silica at the liquid/air interface and then removing the condensed liquid droplet by evaporation, hollow silica half-nanospheres can be easily produced on glass. With our approach, different sizes of half-nanospheres (100-700 nm) can be obtained by controlling the liquid condensation rate relative to the rate of formation of the thin shell of silica. Our approach to produce hollow half-nanospheres is also applicable to a highly nanostructured surface, such as ZnO nanorod substrates.

Keywords: hollow structure, silica, half-nanosphere, nanostructure, condensation, template, arrays.

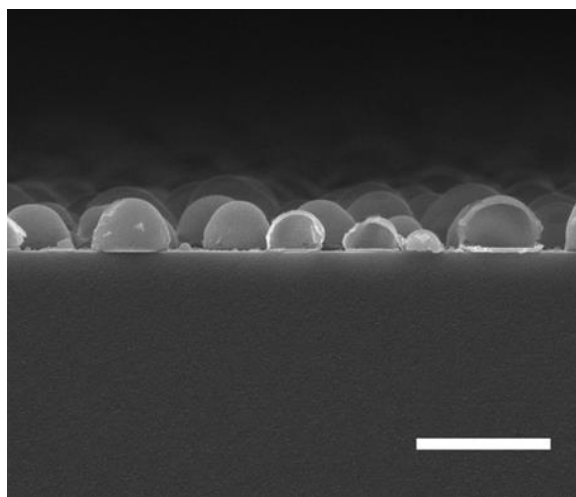


Figure 1: Cross-sectional SEM image of the hollow silica half-nanospheres formed by using condensed liquid as template. Scale bar: 1 μm .

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Gladiator: Graphene Layers: Production, Characterization and Integration – Future of Graphene Production

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Abstract: Research on 2D materials, their Production and properties is a growing tendency in the later years putting together efforts of multinational institutions. GLADIATOR (Graphene Layers: Production, Characterization and Integration) is a research project funded in part by the European Commission and which seeks to improve the quality and size of CVD graphene sheets and to reduce their production costs in order to make the use of graphene more attractive in applications such as transparent electrodes for large area organic electronics or such as hydrophobic polymer foils.

The project will achieve this by: optimizing the performance of CVD graphene, increasing the throughput and size and improving the process by which graphene is transferred from the CVD catalysts to the application substrate. This will be attained by means of control and automatization strategies.

GLADIATOR directly targets the global market for transparent electrodes (estimated to be worth over 11,000 million USD in 2016) and will demonstrate that the performance and price of indium tin oxide can be matched by graphene. An improvement in this field would imply a huge impact in the market, not only for transparent electrodes but for any envisaged graphene layers application.

CVD graphene production will be optimized by implementing diagnostic and process control instrumentation based on Raman spectroscopy and spectrometric ellipsometry; the quality of graphene layers post-transfer will be assured using new non-contact in-line eddy current measurements and THz imaging. CVD production costs per unit area will be reduced not only by process parameter optimization, but also by developing methods to re-use the catalysts and by increasing the size of the reactor chamber. Process safety will also be addressed.

As a demonstration of the capabilities of the project, new graphene based organic optical components (OLEDs and OPDs) will be designed and built on large and cost effective graphene layers.

Keywords: Graphene, 2-D Materials, monitoring technologies, CVD, Raman spectroscopy, spectrometric ellipsometry, eddy currents.

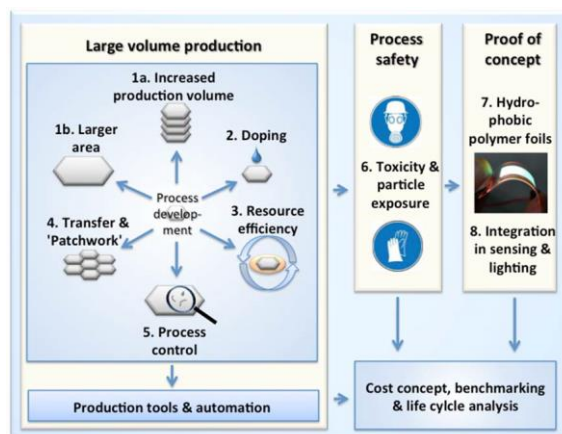


Figure 1: Project flow chart describing the primary tasks to be performed

References:

Sukang Bae, Hyeongkeun Kim, Youngbin Lee, Xiangfan Xu, Jae-Sung Park, Yi Zheng, Jayakumar Balakrishnan, Tian Lei, Hye Ri Kim, Young Il Song, Young-Jin Kim, Kwang S. Kim, Barbaros Özyilmaz, Jong-Hyun Ahn, Byung Hee Hong & Sumio Iijima, Roll-to-roll production of 30-inch graphene films for transparent electrodes, *Nature Nanotechnology* 5,574–578(2010)

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Acknowledge:

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Synthesis and characterization of TiO₂ based inorganic-organic hybrid photocatalysts for enhancing the selective formation of 4-methoxybenzaldehyde from 4-methoxybenzyl alcohol

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Abstract: Nanostructured inorganic-organic photocatalysts were synthesized by grafting a conjugated organic molecule, 4-(4-(4-hydroxyphenylimino)cyclohexa-2,5dienylideneamino)phenol (DIOL), and silver nanoparticles on the surface of two TiO₂ samples. All the three components of the catalysts were home prepared. The structure of DIOL was confirmed by FTIR and ¹H-NMR whereas UV-vis spectroscopy and cyclic voltammetry were carried out to investigate its electronic properties. Diffuse reflectance spectroscopy (DRS), X-ray diffraction (XRD), Scanning electron microscopy (SEM), and Transmission electron microscopy (TEM) were used for structural and morphological characterization of the composites. The powders were tested as photocatalysts for the probe partial oxidation of 4-methoxybenzyl alcohol (4-MBA) to 4-methoxybenzaldehyde (4-MBD) (Augugliaro *et al.*, 2008). In all the photocatalytic runs the powders were stable and allowed to obtain selectivity up to 86%. This figure is the highest ever obtained for alcohol partial oxidation in aqueous media, room temperature and pressure, and under UV irradiation.

Keywords: Photocatalysis, alcohols partial oxidation, nanostructured catalyst, hybrid materials.

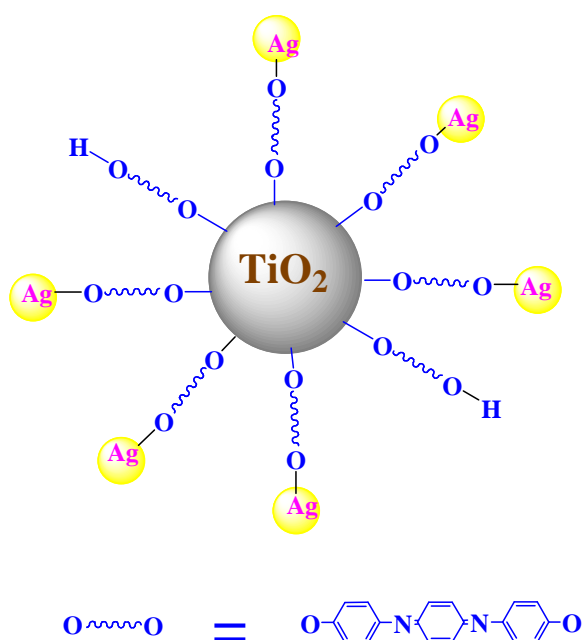


Figure 1: Schematic representation of a nanostructured hybrid TiO₂-based catalyst used for the selective partial oxidation of 4-methoxybenzyl alcohol to 4-methoxybenzaldehyde.

References:

Augugliaro, V., Kisch, H., Loddo, V., López-Muñoz, M.J., Márquez-Álvarez, C., Palmisano, G., Palmisano, L., Parrino, F., Yurdakal, S. (2008), Photocatalytic oxidation of aromatic alcohols to aldehydes in aqueous suspension of home-prepared titanium dioxide 1. Selectivity enhancement by aliphatic alcohols, *Appl. Catal. A: Gen.*, 349, 182–188.

Ion irradiation induced porosity in Ge and Si_{1-x}Ge_x alloys

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Abstract: Ion irradiation of crystalline germanium (c-Ge) results in the formation of a porous surface, and sometimes buried porous layer. The controlled fabrication of such porous structures has potential applications in lighting, gas detection and catalytic applications (Rudawski et al (2013).

In the present work, we employ a combination of complimentary characterisation techniques to better understand the crystalline-to-porous transformation in Ge as a function of implantation conditions (fluence and temperature). This project is also being extended to include the Si_{1-x}Ge_x alloy.

Post-implantation optical profiling indicated that significant swelling of the irradiated layer occurs (up to 200 nm), consistent with the formation of a porous surface layer. The optical result also showed evidence of three distinct regimes of swelling process with ion fluence for pure Ge, whereas the alloys with different fraction of Ge show two different stages of swelling (up to 100 nm). It has been observed by utilizing Raman spectroscopy that the structural properties has a common structure as a function of ion fluence for samples implanted at room temperature and at high temperature. Scanning electron microscopy is also applied to study the morphology as a function of ion fluence and temperature for different concentration of Ge. The pore size is increased as a function of ion fluence as it can be seen in figure 1. The pore shape and depth damage distribution has been investigated by using Transition electron microscopy. Small angle x-ray scattering measurements provided further evidence of an implanted temperature-dependent. There are several mechanisms that can govern the formation of porous structure (Stritzker et al. (2001)) and (Mayer et al (2005)).

Keywords, Nanoporous inGe/ SiGe alloys, Ion implantation, SAXS, SEM, TEM, Optical profiler, Raman. Quantitative analysis.

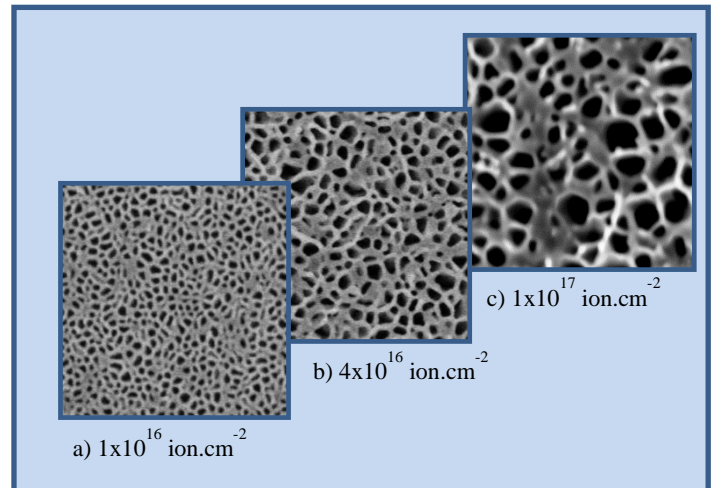


Figure 1: Figure illustrating the porous structure formation as a function of ion fluence. The pore size increased as a function of ion fluence. a) implanting with $1 \times 10^{16} \text{ ion.cm}^{-2}$ b) increasing the fluence to $4 \times 10^{16} \text{ ion.cm}^{-2}$ c) $1 \times 10^{17} \text{ ion.cm}^{-2}$.

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Nanostructured zirconia/graphene oxide hybrids: physico-chemical studies

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Abstract:

The design of new composite materials containing metal or semiconductor nanoparticles is currently an important driving force in many aspects of materials research due to their potential integration in a broad range of technological applications. However, for most applications, effective composites must show porous texture of high surface area and thermal stability (1). In the current study we developed a facile and scalable chemical reduction method assisted by sol-gel technique for the synthesis of chemically converted graphene sheets. The method allows rapid chemical reduction of exfoliated graphite oxide using hydrazine hydrate as a reducing agent in aqueous medium. We focused on synthesizing zirconia / reduced graphene oxide (ZrO_2 /RGO) composite oxide and study their physicochemical properties of such composites. A series of zirconia/graphene oxide (GO) hybrid materials were prepared using sol-gel technique. The nominal composition of GO varied between 0.1-10 mol.% and the prepared hybrids were reduced using hydrazine hydrate prior to calcination in air at 500°C for 4 h. All hybrids showed monoclinic ZrO_2 phase except one with 2 mol.% GO (ZG2) showed tetragonal and monoclinic phases as detected by XRD patterns and Raman spectra. The electrostatic interactions between GO and ZrO_2 during the synthesis may affect the nucleation and in turn the crystallite size of the ZrO_2 . A broad peak appears at 27.1°, corresponding to a graphitic interlayer spacing of about 0.33 nm for the hybrid with 2 mol.% GO. This broad peak may be attributed to disordered restacking of exfoliated, partially oxidized graphene sheets (2). ZG2 hybrid sample showed the largest BET-surface area ($89 \text{ m}^2\text{g}^{-1}$) among all the investigated samples (Figure 1). The pore-size distribution shows an average of 6 to 12 nm for all samples.

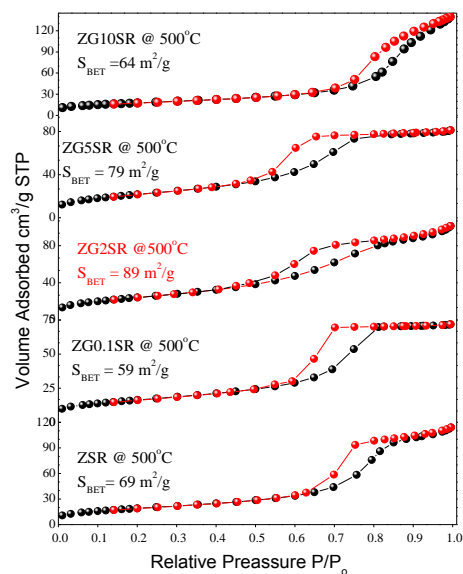


Figure 1: Adsorption/desorption isotherm for all the investigated samples

Keywords: 2D-Graphene, zirconia, sol-gel, hydride materials, nanocomposite, chemical reduction, surface area.

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Biocompatible carbon nanotube/polypeptide hybrids as the platform of biomedical applications and toxicity assessment

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Abstract: The dispersion of carbon nanotubes (CNTs) is of fundamental importance for their use in biosensing, biocompatibility and delivery applications (Gordon K.-C. Lee, Clare Sach et al. 2010; Chandra, Deshpande et al. 2014). There are several methods for the dispersion of CNTs in water using covalent attachment of hydrophilic groups to the surface of tubes (Niyogi, Hamon et al. 2002). These methods, however, alter the electronic structure of the nanotubes by disrupting the network of sp² hybridized carbons. In order to keep the nanotubes' intrinsic mechanical and electrical properties intact, non-covalent interactions are increasingly being explored as an alternative route for dispersion. Apart from conventional surfactants such as sodium dodecylsulfate (SDS) or sodium dodecylbenzenesulfonate (SDBS) which are highly effective in dispersing CNTs, biopolymers have received much attention as dispersing agents due to the anticipated biocompatibility of the dispersed CNTs (Ximenes, Melo et al. 2012). Also, The pyrenyl group is known to interact strongly with the basal plane of graphene via π -stacking. In this study, a highly re-dispersible biopolymer is reported for the synthesis of pyrene-modified poly-L-lysine (PBPL) and poly(D-Glu, D-Lys) (PGLP). To provide the evidence of the safety of the PBPL/CNT & PGLP/CNT materials we use in this study, H1299 and HCT116 cells were incubated with PBPL/CNT & PGLP/CNT materials for toxicity analysis, MTS assays (Figure 1). The results from MTS assays indicated that no significant cellular toxicity was shown in H1299 and HCT116 cells. Furthermore, the fluorescence marker fluorescein isothiocyanate (FITC) was added to PBPL & PGLP dispersions. From the fluorescent measurements showed that the chemical functionalisation of the PBPL/CNT & PGLP/CNT conjugates with the fluorescence marker were successful. The fluorescent PBPL/CNT & PGLP/CNT conjugates could find application in medical imaging. The applicability of such soluble and chemically functionalised polypeptide/CNT conjugates in biomedicine is currently investigated. We expect that this polypeptide/CNT system will be a safe and multi-functional nanomedical delivery platform and contribute to future medical therapy.

Keywords: carbon nanotube, nanotoxicology, biomedical applications, polypeptide/CNT hybrids.

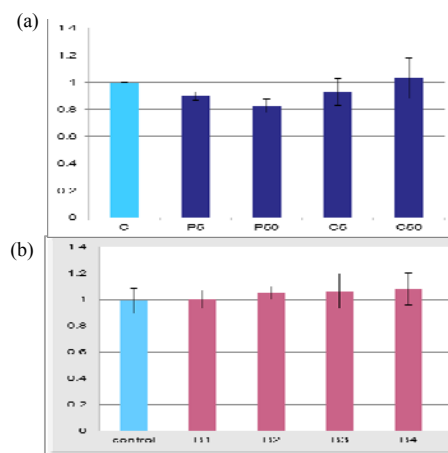


Figure 1: (a) H1299 cancer cells were incubated with PGLP/CNT materials for 72 hours, and then cells were analyzed by MTS cell proliferation assay. The relative survival compared to untreated control cells is shown here; (b) HCT116 cancer cells were incubated with PBPL/CNT materials for 72 hours, and then cells were analyzed by MTS cell proliferation assay. The relative survival compared to untreated control cells is shown here.

References:

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Gold Nanoparticle Loaded Core-CrossLinked MPEG-b-PGMA Micelles

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Abstract:

In addition to applications as surfactants and in personal care products, block copolymer micelles have been extensively investigated as nanoparticles for solubilizing active agents for drug delivery, or as nanoreactors for the production of inorganic nanoparticles, e.g. of metals with potential applications in catalysis (Hamley 2004). However, the practical applications of micelles are limited due to their structural instability since the micellar structure can hardly keep stable upon dilution or changes of external conditions such as changes in pH, ionic strength, solvent change and temperature (Read and Armes 2007). In order to enhance the stability, core cross-linked (CCL) and/or shell cross-linked (SCL) micelles were then developed (Read and Armes 2007, Van Nostrum 2011). SCL micelles are generally prepared at high dilution in order to avoid undesirable intermicellar cross-linking and thus the efficiency is quite low. Probably the more suitable method is to carry out core crosslinking (CCL) instead of SCL (Bütün, Wang et al. 2000).

Block copolymers have been used as nanoreactors for the synthesis of inorganic nanoparticles (Hamley 2003). Nanometals have attracted much attention in the fields of physics, chemistry, and biology owing to their unique chemical and physical properties as well as their potential technological uses in magnetism, electronics and catalysis. Their potential technological uses are strongly dependent on the sizes, compositions, and shapes of metal nanomaterials (Forster and Antonietti 1998, Cohen 1999, Hamley 2003, Bradley 2007). The micelle formation due to interaction or complex with metal compounds, fine control on colloid morphology can be provided, which leads to monodispers particles (Chan, Craig et al. 1992, Sidorov, Bronstein et al. 1999).

Keywords: CCL micelles, core cross-linked micelles, diblock copolymer, catalyst, metal nanoparticles, Au NPs, gold nanoparticles

In this study, poly(ethylene glycol)methyl ether-*block*-poly(glycidyl methacrylate) diblock copolymer (MPEG₄₅-*b*-PGMA₆₃, Fig. 1) was synthesized via ATRP method and polymeric micellar solution was prepared by dissolving 0,1 g of MPEG₄₅-*b*-PGMA₆₃ in 11 mL of water. Ethylene diamine was added to the micellar solution and stirred at 25 °C. CCL micelles were synthesized with cross-linking reaction between the epoxy functional group of poly(glycidyl methacrylate) block and ethylenediamine. The core of the micelles containing -OH, -NH and -NH₂ groups (Fig.2) are highly hydrophilic character and stable micelles are unaffected from environmental conditions.

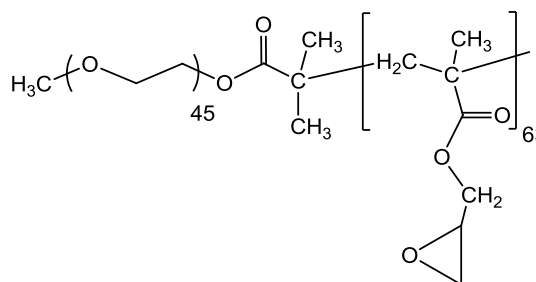


Figure 1. MPEG₄₅-*b*-PGMA diblock copolymer

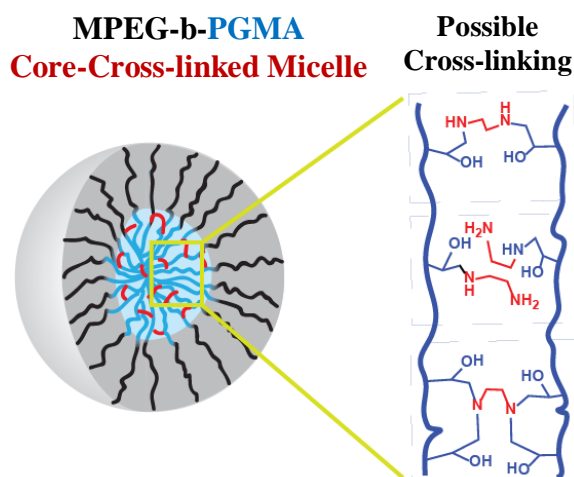


Figure 2. Schematic representation of the MPEG-*b*-PGMA core crosslinked micelles

Metal salt –micelle solutions were prepared by the addition of H₂AuCl₄ metal salt (epoxide-metal salt molar ratio of 4:1 and 8:1) to the CCL micellar solution. The solution was

stirred at room temperature for 3 hours. Then, the aqueous solution of NaBH_4 was added to the medium as reductant and stirring process continued for 2 hours in ultrasonic bath.

TEM images indicated that the average diameters of the micelles were around 25 nm and synthesized Au nanoparticles in the CCLs were around 5 nm. The hydrodynamic diameters of CCL micelles were also determined by Dynamic Light Scattering studies and well agreed with TEM results. Au NP-CCL micelle dispersions were stable more than 6 months.

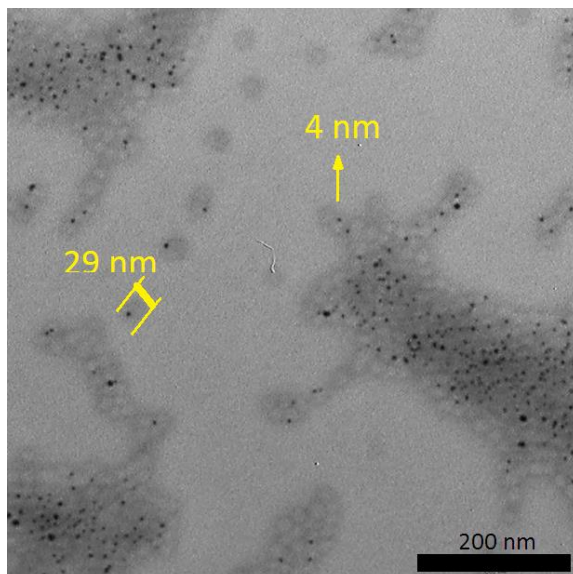


Figure 3. TEM image of Au NP/MPEG-PGMA CCL micelle solution

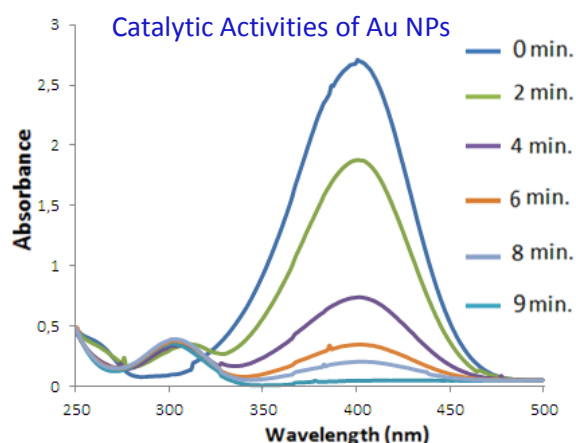


Figure 4. Catalytic activity of Au NPs

The catalytic efficiencies of Au NP-CCL micelle dispersions were investigated in the reduction of p-nitrophenol with NaBH_4 . The reduction was conducted in a standard quartz cell with a path length of 1 cm. 2.5 mL of NaBH_4 (0.01 M) was mixed with 20 μL of p-nitrophenol (1.0 mM). Immediately after addition 2.5 μL of dispersion. The UV-Vis absorption spectra were recorded at certain time interval in a

scanning range of 250–550 nm. As seen in Figures 4, the decrease in intensity of UV absorption at 400 nm in very short time scale was the indication of its good catalytic activity in the reduction of p-nitrophenol (or the increase in absorption intensity at 300 nm corresponding to p-aminophenol). The full conversion of p-nitrophenol to p-aminophenol was observed within 9 minute. Au NP-CCL micelle dispersion showed good catalytic activity in the related model reaction.

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Synergistic effect of Doxorubicin-loaded core-shell silver/PEG nanoparticles on breast cancer cells

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Abstract:

In an attempt to find an effective cancer therapy, nanotherapeutics comes onto the scene as a new therapeutic approach, which is emerging both nanotechnology and biotechnology. Nanotherapeutics offer tremendous advantages over conventional cancer therapy including prolonged drug systemic circulation half-life, targeted drug delivery and nanoparticles-based combination therapy. The advantages of nanotherapeutics result in improving drug pharmacokinetic profile and efficacy/toxicity balance [1-4]. Recently, ongoing studies regarding cancer therapy are focusing on the anticancer action of various inorganic nanoparticles such as silver (AgNPs) nanoparticles, which demonstrated a potent anticancer action on different cancers [5-6]. The main objective of this study was to utilize the anticancer activity of AgNPs and doxorubicin and formulate nanoparticles-based combinatorial therapy and *in-vitro* evaluated on breast cancer (MCF-7) cells. The estimated IC₅₀ values obtained following MTT assay were: 3.7 μg/ml for DOX and 0.14-3 μg/ml for DOX-Ag/PEG NCs. These results confirmed that a synergistic anticancer effect is induced by DOX- Ag/PEG NCs, which could be possibly ascribed to: (i) the combined cytotoxic effect of AgNPs with the therapeutic effect of DOX and (ii) the enriched internalization of DOX-Ag/PEG NCs via endocytosis, allowing the release of DOX inside the cell as compared to the passive diffusion of free DOX into the cells (Figure 1). We believe that this is the first report on a significantly enhanced cytotoxic effect of DOX against MCF-7 cells. These finding could aid in formulating a novel targeted strategy for cancer therapy that can potentially eradicate cancer cells selectively and effectively while minimizing adverse side effects.

Keywords: Nanoparticles-Combinatorial therapy, Silver Nanoparticles, doxorubicin, Breast cancer

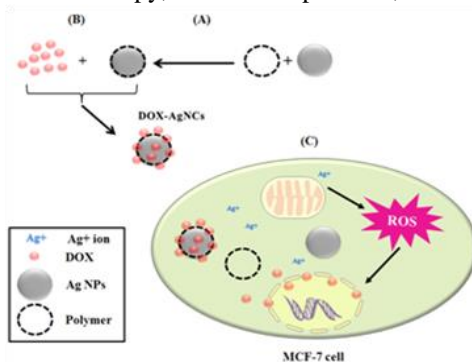


Figure 1: Schematic illustration of the possible mechanism of action behind the resultant synergistic cytotoxic effect of DOX-loaded core-shell Ag/PEG NCs at very low dose of DOX on MCF-7 cells.

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Structural parameters of nanocrystalline calcium phosphate using CTAB as a cationic template

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Abstract: Thanks to nanotechnology, new materials are being fabricated with special properties used in a variety of applications, such as the materials used as implants or bone substitute in the human body, these must be adapted to the changes that occur in the bone as it reconstructs constantly. The main bone component is the calcium phosphate denominated as hydroxyapatite. The human body is constantly reabsorbing this and reconstructing new bone. In this way the body adjusts the bone width in response to the change of weight distribution with the body. Synthetic nanostructured ceramics have been developed in order to react with the body fluids so apatite can be formed, which is the natural ceramic in the bone. But the idea is to go further. Not only pure mechanical zones, like articulations or extremities, can be replaced: to this day, corneal blindness can be treated using a cornea transplant. In the present work the employed technique was precipitation as a simple technique for the obtaining of nanocrystalline calcium phosphate with the goal of producing odonto keratoprosthesis and therefore avoid the canine tooth extraction surgery as it is an expensive operation, actually this synthesis route was used in order to save time and see how the results are affected by modifying the variables. As a result infrared spectroscopy and x-ray diffraction were obtained. No XRD impurities were detected other than calcium phosphate as a result of the pH variation. In the infrared spectra shown a very small amount of the CTAB molecule is incorporated in the calcium phosphates.

Keywords: nanocrystalline calcium phosphate, physicochemical parameters, synthetic nanostructured ceramics, infrared spectroscopy, x-ray diffraction, biomedical applications.

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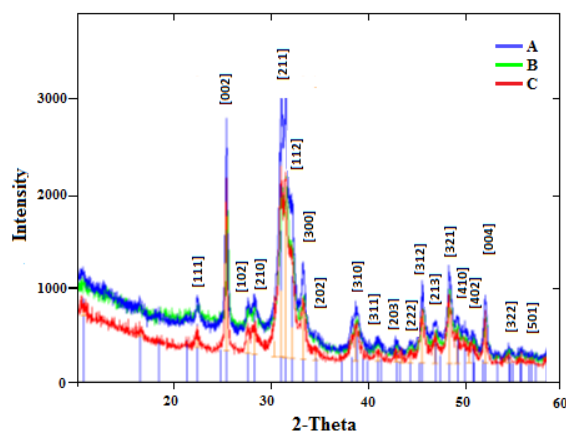


Fig.1 XRD diffraction patterns of samples A, B and C.

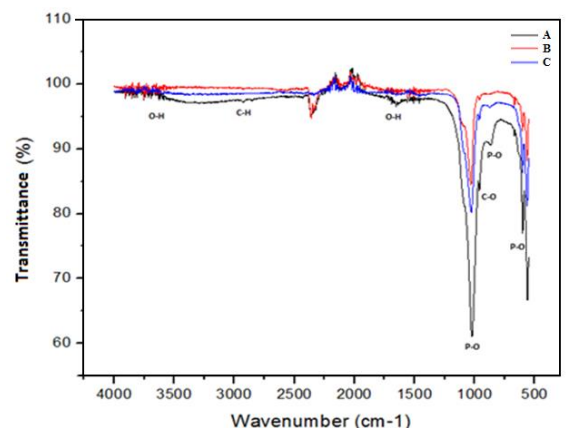


Fig. 2. FT- IR spectrum of samples A, B and C.

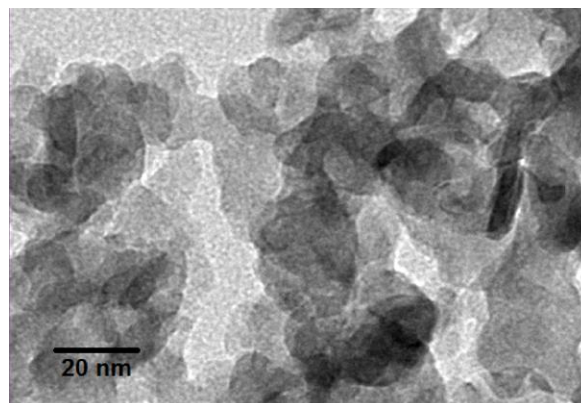


Fig. 3. Morphology of nanorods.

Estimation of Tramadol in Earwax and Urine: A comparative Study

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Abstract:

The aim of this study is to determine tramadol in earwax and urine samples taken from postoperative patients, evaluation of the sensitivity of earwax as an alternative sample and comparing it with the findings in urine samples and compare results obtained in this study with similar studies in the world. Urine and earwax samples (40 of each) from postoperative patients who were receiving tramadol and a consent form that is distributed to patients were collected in King Abdullah University Hospital (KAUH). Tramadol was analyzed using high-performance liquid chromatographic (HPLC) with fluorescence detector. Tramadol was detected in all earwax samples at a concentration of (13.5 – 107.7 µg/g) with a mean concentration of (44.5 µg/g), while in all urine samples tramadol was detected at a concentration of (1.57- 10.11 µg/mL) with a mean concentration of (6.04 µg/mL). Statistical analysis was performed by one-way analysis of variance (ANOVA) followed by Tukey Test to evaluate significant differences between groups. There were no significant differences between age groups, duration and gender in earwax and urine since values of $P > 0.05$. In addition statistical analysis shows that there were significant differences when comparing age groups, duration and gender in earwax and urine. ($P < 0.05$). Also in this study the mean value of tramadol concentration in earwax and urine were (44.5) µg/g, (6.04) µg/mL respectively. When comparing the results of this study to the results mentioned in (Table 4), data shows that earwax sample has a higher concentration of tramadol compared with hair sample (0.21) µg/g. Also they have a higher tramadol concentration when compared with plasma (0.0036) µg/mL and saliva (0.0033) µg/mL. Blood has a higher concentration (0.48) µg/L than earwax and urine.

Keywords: Tramadol, ear wax, urine, HPLC.

Bismuth Sulphide Nanoparticles coated with PVP and DSPE-PEG as contrast agents for X-ray Computed tomography imaging (CT)

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Abstract: Nanotechnology has been shown to have enormous potential to enhance the field of radiology by providing an improved medical imaging platform for better diagnosis, improved disease characterisation, and improved monitoring of response to therapy[1]. The incorporation of these materials with medical imaging devices such as CT scans has been demonstrated to overcome many of shortcomings of traditional iodinated contrast media. The optimal nanoparticulate CT contrast medium needs to have a high X-ray attenuation coefficient, low toxicity, a long circulation time, and be cost effective[1, 2]. The purpose of this research is to develop and characterize a Nano-particle and incorporate it into the processes employed by current diagnostic CT imaging devices in order to enhance the device sensitivity and increase the chance of identifying disease at a time when the patient can receive a positive prognosis. This enhancement is also of importance in terms of advancing towards elimination of the need for invasive biopsy, which is the most accurate diagnostic method for cancer detection and therapy follow up. Here we propose the use of bismuth-based nanoparticles that are non-toxic and are one of the least expensive heavy metal-based nanoparticles. In addition, bismuth-based nanoparticles improve x-ray attenuation and hence, they can be used as contrast agents. This research will focus in bismuth sulphide nanoparticles, specifically on their synthesis, characterisation and use as contrast agents for CT. These nanoparticles can be synthesised using a facile strategy for the production of well-dispersed nanoparticles of small size, which are stable in water for a long period of time. This method is based on using bismuth neodecanoate and thioacetamide as bismuth and surfer sources and oleic acid as a stabilizer[3]. The nanoparticle surface can be modified using PVP and DSPE-PEG biocompatible polymers. The preliminary results revealed that PVP surface coating yielded superior results with CT when these nanoparticles were compared to the nanoparticles have been coated with PEG.

Key Words: Bi₂S₃ Nanoparticles, Contrast Agents, Computed tomography imaging, PVP, DSPE-PEG, polymer.

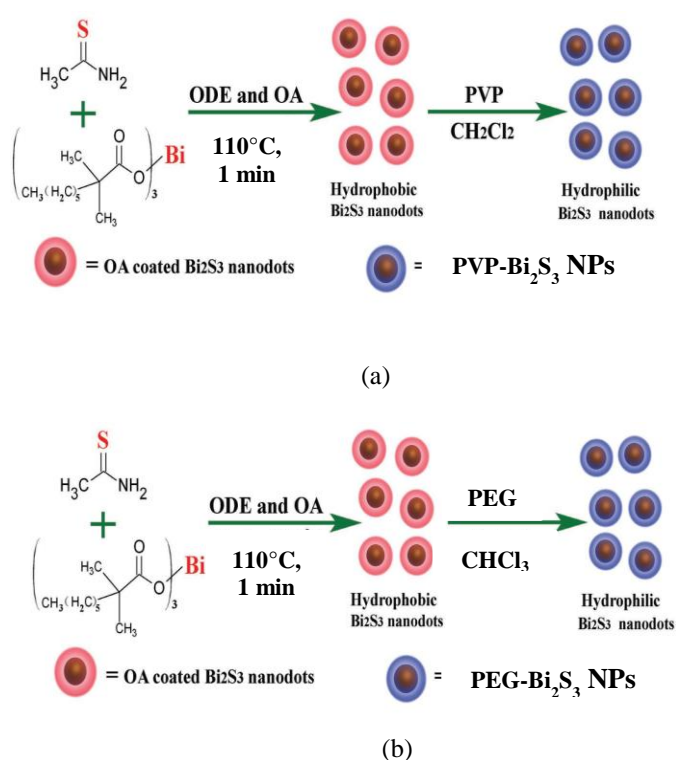


Illustration of synthesis and surface modification of Bi₂S₃ NPs with (a) PVP [3] and (b) DSPE-PEG.

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Microencapsulation of Phenobarbital by EthylCellulose matrix

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The aim of this study was to evaluate the potential use of EthylCellulose in the preparation of microspheres as a Drug Delivery System for sustained release of phenobarbital.

The microspheres were prepared by solvent evaporation technique using ethylcellulose as polymer matrix with a ratio 1:2, dichloromethane as solvent and Polyvinyl alcohol 1% as processing medium to solidify the microspheres. Size, shape, drug loading capacity and entrapment efficiency were studied.

An optimization procedure was employed to investigate and identify the key parameters affecting the properties of the microspheres.

Key words : phenobarbital, microspheres, ethylcellulose, polyvinylalcohol

Bioencapsulation of aminocetophen (paracetamol) in ethylcellulose matrix and study of its drug delivery from microparticles

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Microsphere carrier systems, made from natural polymers are attracting considerable attentions for several years, for sustained drug delivery. Today, those dosage forms which can control the release rates and which are target specific have a great impact in development of novel drug delivery systems. Microspheres are part of such novel delivery systems (Woo et al 2001, Capan et al; 2003, Gogel et al; 1998). The aminocetophen is an antalgic medicine used mainly for rheumatismal disease but its delivery system is not yet well developed, the reason for what we were interested in the present research work by developing a sustained drug delivery system of this antalgic agent. However, ethylcellulose microspheres containing aminocetophen were prepared and evaluated for in-vitro performance of this drug. Our microspheres based on ethylcellulose as matrix were prepared by "solvent evaporation method". Ethylcellulose was used as matrix polymer in which drug was dispersed because of its biodegradability and hydrophobic characteristic. The surface morphological characteristics of ethylcellulose microspheres were investigated using scanning electron microscopy. The (drug/polymer) ratio, emulsifiers and blades number affected the particle size, shape and surface morphology of microparticles (**figure 1**). The in-vitro drug release is carried out using UV-Visible spectrophotometric apparatus at 273nm as a maximal wavelength, in acidic medium (pH=1.2 at 37°C) and our first aim is well to make better the late effect of paracetamol's delivery system.

Keywords: bioencapsulation, microspheres, drug delivery system, sustained release, aminocetophen.

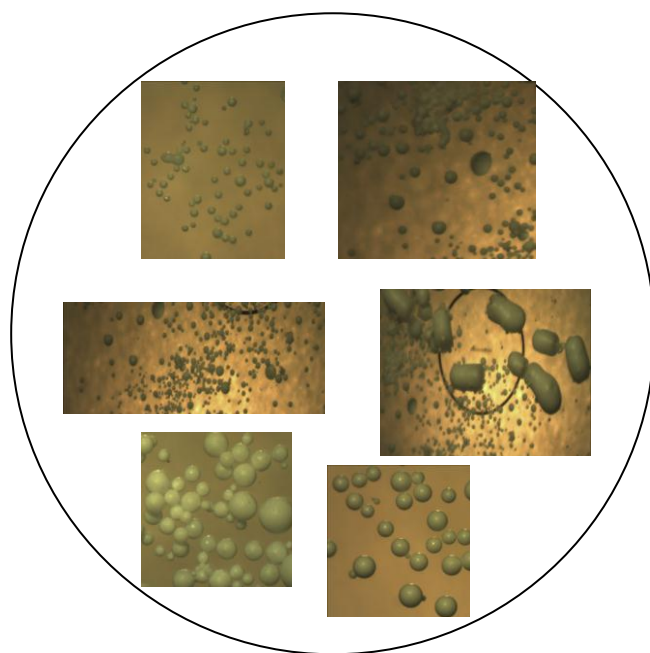


Figure 1: some microscopic analyses illustrating the effect of (drug/polymer) ratio, emulsifiers and blades number on the particle size, shape and surface morphology of microparticles.

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Microfabricated Pseudocapacitors Using Ni(OH)₂ Electrodes Exhibit Remarkable Volumetric Capacitance and Energy Density

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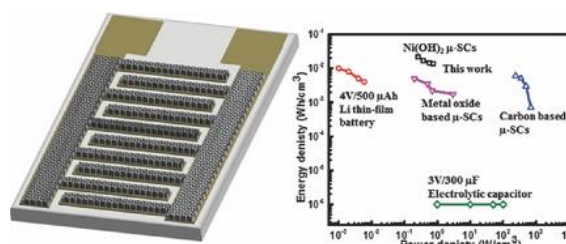
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Abstract: Metal hydroxide based microfabricated pseudocapacitors with impressive volumetric stack capacitance and energy density are demonstrated. A combination of top-down photolithographic process and bottom-up chemical synthesis is employed to fabricate the micro-pseudocapacitors (μ -pseudocapacitors). The resulting Ni(OH)₂-based devices show several excellent characteristics including high-rate redox activity up to 500 V s⁻¹ and an areal cell capacitance of 16 mF cm⁻² corresponding to a volumetric stack capacitance of 325 F cm⁻³. This volumetric capacitance is two-fold higher than carbon and metal oxide based μ -supercapacitors with interdigitated electrode architecture. Furthermore, these μ -pseudocapacitors show a maximum energy density of 21 mWh cm⁻³, which is superior to the Li-based thin film batteries. The heterogeneous growth of Ni(OH)₂ over the Ni surface during the chemical bath deposition is found to be the key parameter in the formation of uniform monolithic Ni(OH)₂ nanosheets with vertical orientation, responsible for the remarkable properties of the fabricated devices. Additionally, functional tandem configurations of the μ -pseudocapacitors are shown to be capable of powering a light-emitting diode.

Keywords: micro-pseudocapacitors; redox reactions; Ni(OH)₂; flexible materials; solid state electronics



Summary Figure: A conventional photolithography process followed by chemical bath deposition of Ni(OH)₂ is used in the fabrication of micro-pseudocapacitors. The micro-pseudocapacitors exhibit superior energy density compared to lithium based thin-film batteries and carbon and metal oxide based micro-supercapacitors.

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Kurra, N., Nuha .A. Alhebshi, and H.N. Alshareef, *Microfabricated Pseudocapacitors Using Ni(OH)₂ Electrodes Exhibit Remarkable Volumetric Capacitance and Energy Density*. *Advanced Energy Materials*, 2014: p. n/a-n/a, DOI: [10.1002/aenm.201401303](https://doi.org/10.1002/aenm.201401303)

Electrical Contacts to Organic Molecules (DNA) using Nano transfer printing technique

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Abstract: Nowadays, researchers and chemistries can control and even tailor the electronic properties of organic molecules via usual known chemical procedures. However, due to the immense lake of control, understanding and investigating the electrical contacts between the organic molecule and inorganic electrodes, the technological advances in molecular-electronics are still in their initial steps. Performing good and robust electrical contacts is a critical task with the organic molecules due to their chemical and mechanical weakness (Cheol *et al.*; 2014). In this work, we propose nano-transfer printing technique (nTPT) in order to print robust inorganic-contacts onto molecular devices. This technique s by far simpler and has more performance than the typical metal evaporation techniques (Carlson *et al.*; 2012).

Nano transfer printing technique (nTPT) is used to produce electrical robust electrodes (contacts) to dioxyribonucleic acid molecule (DNA) (Wang *et al.*; 2014). AC- and DC-(IV) characteristics have been conducted to examine and evaluate the new electrical contacts. nTPT leads to robust and excellent electrical contacts where the experimental results show good charge transfer through the electrodes with minimum additional electrical resistance due to electrodes. While, on the contrary, when one evaporates nano gold on DNA surface (typical method), this leads to high electrical resistance at the electrode zone.

Acknowledgments

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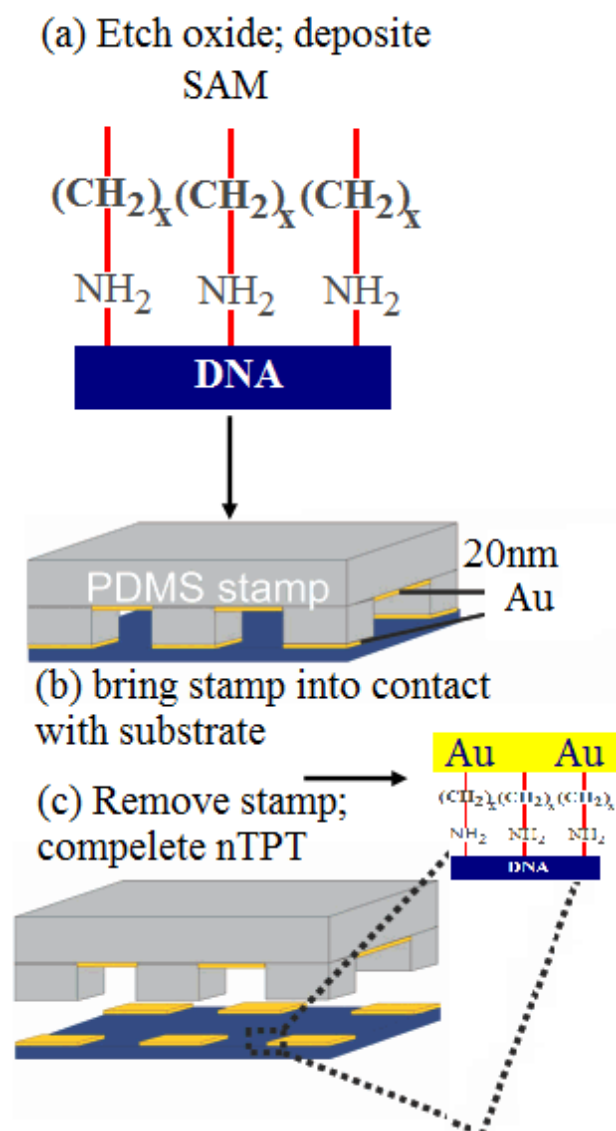


Figure 1 (a) DNA molecule is first etched with dilute ammonium hydroxyl for two minutes and then subjected to solution of nano-acetylene $(CH_2)_x$ polymer for one quarter hour. (b) A "stamp" of plant design management system (PDMS) with suitable relief characteristics. (c) Get off the stamp and printing is completed.

Charge-Transport Properties across Self-Assembled Monolayers Using $\text{Ag}^{\text{TS}}/\text{SAM}/\text{Ga}_2\text{O}_3/\text{EGaIn}$ Junctions

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Abstract: Interest in molecular electronics has developed, in part, based on the proposition that organic synthesis would enable so-called “wave-function engineering,” and that current-voltage characteristics of junctions containing organic compounds could be tailored through modifications of molecular structure (Metzger, 1999). On the other hand, electron transfer is a fundamental process in protein assemblies—controlling processes such as photosynthesis and respiration—and is characterized by efficient rates of charge transport occurring over considerable distances (up to 100 Å) (Cordes and Giese 2009). The mechanism of charge transport through proteins remains undefined (i.e., whether it involves tunneling or inelastic hopping, or both), and may depend on some combination of the length of the peptide, the presence of secondary structure, and possibly the presence of specific side chains (Arikuma, *et al* 2009). This paper (i) describes the relationship between molecular structure and rates of charge transport by tunneling through self-assembled monolayers (SAMs) upon embedding an amide (either $-\text{CONH}-$ or $-\text{NHCO}-$), a urea ($-\text{NHCONH}-$) or thiourea ($-\text{NHCSNH}-$) group into the molecules constituting the SAM, and (ii) characterizes the rate and the efficiency of charge transport across a short sequence of peptides containing glycine as the side chain. The results show (i) the insensitivity of tunneling current to the embedded dipolar groups (amide and urea) at low potential (0.5 V) but significant current rectifications at high potential (1.0 V), and (ii) that incorporating glycine residues into SAMs of alkanethiolates results in an indistinguishable value of the injection current density ($\log|J_0|$) but a smaller value of the tunneling decay factor, β , compared to n-alkanethiolates.

Keywords: Molecular electronics, electron transfer, large-area function, SAMs, rectification; dipole moment, alkanethiolates, peptides.

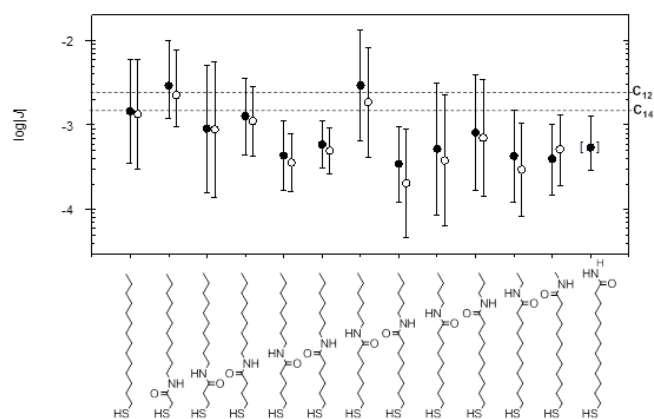


Figure 1: A summary plot of current density ($\log|J|$) at +0.5 V (\bullet) and -0.5 V (\circ) of amide-containing alkanethiolates ($\text{C}_m\text{-CONH-C}_n$).

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First principles calculations of structural and optoelectronic properties of cubic perovskite CsBeF₃

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Abstract: We have investigated the structural, electronic and optical properties of a compound perovskite CsCaF₃ using the full-potential linearized augmented plane wave (FP-LAPW) method within density functional theory (DFT) [1]. In this approach, both the local density approximation (LDA) [2] and the generalized gradient approximation (GGA) [3] were used for exchange-correlation potential calculation. The ground state properties such as lattice parameter, bulk modulus and its pressure derivative were calculated and the results are compared with theoretical data. Electronic and bonding properties are discussed from the calculations of band structure, density of states and electron charge density, where the fundamental energy gap is direct under ambient conditions. The contribution of the different bands was analysed from the total and partial density of states curves. The optical properties (namely: the real and the imaginary parts of the dielectric function $\epsilon(\omega)$, the refractive index $n(\omega)$ and the extinction coefficient $k(\omega)$) were calculated for radiation up to 35.0 eV. This is the first quantitative theoretical prediction of the electronic and optical properties for the investigated compound and still awaits experimental confirmations.

Keywords: DFT, Fluoroperovskite, electronic structure, optical properties.

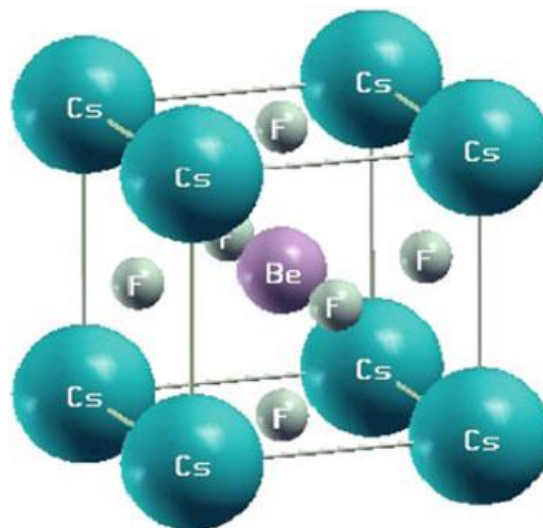


Figure 1: The crystal structure of CsBeF₃.

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Modeling of the structure GaInAsN/GaAs for solar Cells applications

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Abstract: This work focuses on modeling and simulation of quaternary strained $Ga_{1-x}In_xAs_{1-y}N_y$ on GaAs substrate, for a solar cell applications. Theoretical model was used to study the effects of the incorporation of indium (In) and nitrogen (N) concentrations in the GaInAsN materials. In order to implement this study a simulation program was developed to determine the strain effect on the band energy. We also considered the influence of In and N on the bands energy. In this study we used the band anticrossing (BAC) model. Indeed, a strain reduces the bandgap energy. Also the nitrogen incorporation splits the conduction band into two sub-bands $E^{(+)}$ and $E^{(-)}$. It was treated the impact of indium and nitrogen concentrations on the absorption coefficient on GaInAsN/GaAs structure. Increased In and N induced an increase absorption coefficient. This work allows us to optimize In and N concentrations to raise the efficiency of a solar cell based on GaInAsN/GaAs structure..

Keywords: Novel materials, semiconductor, optoelectronics, solar cells;

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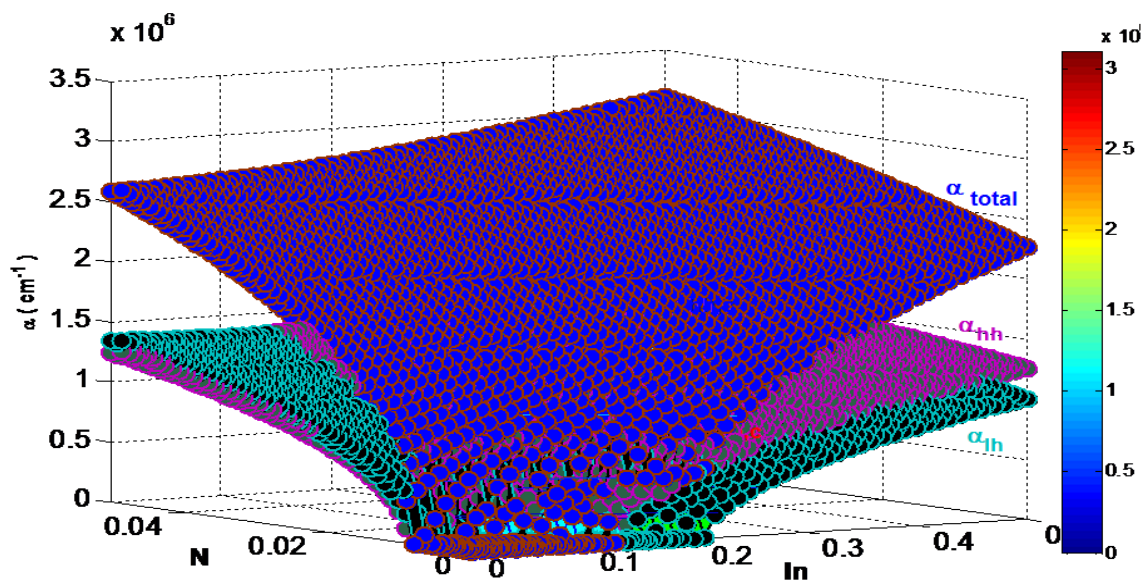


Fig. variation of the absorption coefficient in function of the nitrogen and bismuth concentrations

Nanoholes: high speed surface nanomachining for optical performance improvement

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Abstract: In the later years with the development of the photonic crystals technology and the optical simulation models the manipulation of material optical properties by surface modification in nanometric scale is becoming popular. Optical paths creation for light propagation controlling or adaptation the reflection-transmission ratio is possible. This surface nano manipulation is a promising method to improve the optical properties of some materials and the performance of light-based components (i.e. mirror, lenses, lasers, photodiodes or light absorbers).

The Nanoholes project was aimed to use this effect for the efficiency enhancement of solar photovoltaic components by microstructuring surfaces with nanoholes and nanorods. Optical performance simulations for the envisaged nanostructures were performed. With these models different technologies for fast generation of these structures were studied including photolithographic, stamping, and ablative methods. A comparative study was performed on silicon substrates showing that laser interference based techniques offered faster processing, with less steps and no extra layers addition.

Of all these interference techniques the direct laser interference ablation one was found to have the best properties and the selection of the proper optical configuration was chosen by means of energy pattern simulation. A development for best performance of the process was carried out, always having the implementation on a industrial environment of an affordable tool as a goal. With the proper automation of components a maximum feed rate can be attained (limited only by the laser source). However, long time tests showed that the calibration of the optical configuration was laborious and sensible, inadequate for industrial environment. Therefore, a laser head was designed fixing the beam paths and allowing controlled variation in case the pattern should be changed. Together to that an additional automated work cell, a productive process in large areas is possible without the classic “in-lab” procedures.

Keywords: surface modification, photonic crystals, direct laser interference patterning, solar cells, photovoltaics, Nanostructuring

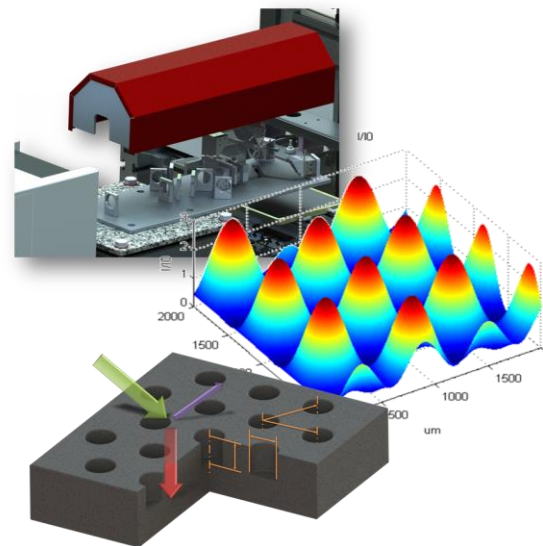


Figure 1: Illustration of the project development from the simulation of the photonic crystals optical properties, the interference pattern calculation and the desing of an innovative laser head to be attached in the automation of a work cell

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Modification of nanoclay and its application for the removal of Cadmium from water samples

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Abstract: Nanoclays are known for their excellent sorption properties toward pollutants from the environment. Montmorillonite (MMT) is nanoclay that have been used to remove toxic metal ions and organic compounds. For increasing capability of adsorption it is possible to modify the surface properties of MMT greatly by replacing exchangeable cations with other cations such as metal ions and quaternary ammoniums (Zhang et al., 2014).

Cadmium has been described as one of the most dangerous trace elements in the environment. This element accumulates in living organisms and has a high toxic potential (Pourreza and Zavvar Mousavi, 2004). Several methods have been studied for removal of Cd(II) from aqueous solutions. Adsorption is considered as a very effective and economical process for metal ion removal from wastewaters (Zhao et al., 2011). The adsorbents, which have high surface area and adequate sites for adsorption, are preferred in adsorption of heavy metals. Therefore in this study, montmorillonite was selected. The high specific surface area, chemical and mechanical stability, layered structure, high cation exchange capacity, etc., have made the nanoclays excellent adsorbent materials (Elhami et al., 2013). Montmorillonite (MMT) was modified with dithizone (Dz) to produce adequate sites for cadmium adsorption because dithizone is a sulfur-containing organic compound that is a good ligand, and forms complexes with many metals. Modified montmorillonite was characterized by FT-IR spectroscopy, XRD and SEM techniques. The FT-IR spectrum (Fig.1) of Dz-MMT indicated the presence of new bands at about 1498, 1458, 1438 and

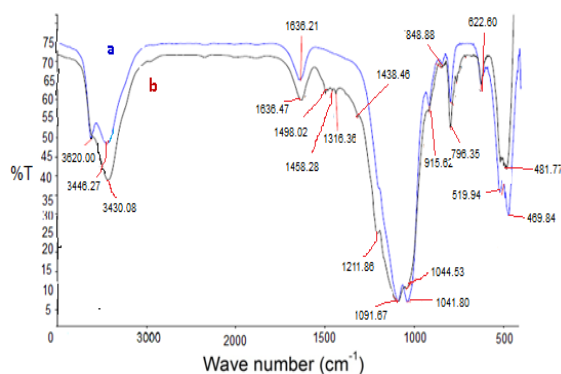


Fig.1: FT-IR spectra of (a) MMT (b) MMT-DZ

1316 cm⁻¹ corresponding to the N-H (bending), aromatic compound, N-N and C-N (stretching) absorption bands, respectively. These results confirmed that the MMT was modified by dithizone. To investigate the modification, the diffraction spectrum of x-ray was taken between 2 theta of 5° to 15° from pure montmorillonite and also for modified montmorillonite (Fig. 2). The shift of the XRD peak from 7.24 to 6.12 can be attributed to re-orientation of the organic compound between MMT layers (Patel et al., 2006; Manocha et al., 2008).

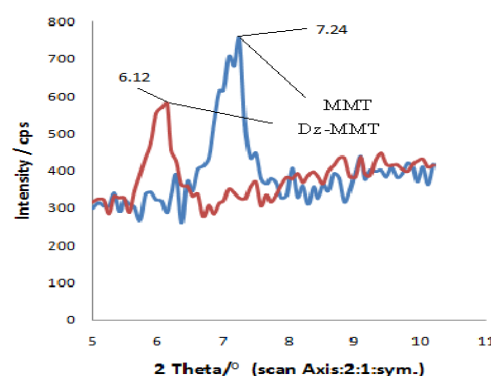


Fig. 2: XRD spectra of (a) MMT (b) MMT-DZ

The surface morphologies of the MMT and Dz-MMT were studied using scanning electron microscopy (SEM). Micrographs of the surface of each material are shown in Fig. 3(a)–(b) at 5000 times magnifications. They are typical of the overall surface of each sample. Fig. 3(a) corresponds to the raw MMT which shows that MMT consists of small particles and has a nonporous surface; however, it was not compact. After the fabrication of the Dz-MMT composite, as it is presented in Fig 3(b), the sharp sheets were observed due to the coating of Dz onto the surfaces of MMT.

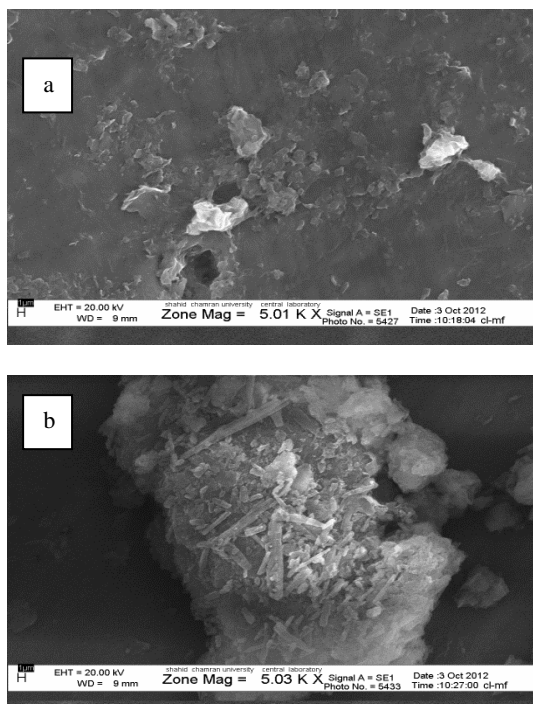


Fig. 3: SEM images of MMT (a) and Dz-MMT (b) at 5000 times magnifications

Afterward, the synthesized composite was used for removal of Cd (II) from water samples. Cd(II) was removed more than %64 in initial tests using Dz-MMT while was removed about 10% using MMT, in the same condition. The effects of pH of solution (2.5-10.0), adsorbent dose (0.4-2.0), adsorption time (10-100) and agitation Rate (60-140) on the adsorption of Cd (II) on Dz-MMT have been investigated. The modified MMT had a high uptake capacity in room temperature and removed Cd (II) (20 mg L^{-1}) of about 92%, in 30 min, with only 1.0 g/L of adsorbent. In all the cases of optimization, the cadmium used had a concentration of 20 mg L^{-1} . In order to study the possibility of dye removal in other concentrations with the same optimization condition, other concentrations were studied, as well. From the experimental results, it was found out that for Cd (II) concentrations ranging $5\text{--}70 \text{ mg/L}$, quantitative removal was obtained in a single adsorption. Langmuir and Freundlich isotherms were employed for the study of the adsorption of Cd (II) onto Dz-MMT which were well in line with both Langmuire and Freundlich equations. Pseudo-first and pseudo-second-order kinetics models were tested with the experimental data, and pseudo-second-order kinetics was the best. The effects of various ions as potential interference on the removal of cadmium were investigated. Known concentrations of potential interfering ions were added to a solution containing 20 mg/L of Cd(II). The solutions were analyzed by the proposed method. The tolerance limit of each foreign ion substance was taken as the largest concentrations yielding an error of less $\pm 5\%$. The results showed that

BrO_3^- , $\text{Cr}_2\text{O}_7^{2-}$, Br^- , NO_3^- , Cl^- , HPO_4^{2-} , K^+ , Mg^{2+} , Ag^+ , NH_4^+ (up to 200 mg/L), SO_4^{2-} , Na^+ , Ca^{2+} (up to 100 mg/L) and CH_3COO^- , S^{2-} , Pb^{2+} , Cu^{2+} , Ni^{2+} (up to 20 mg/L) are tolerable. The method was applied to the removal of Cd (II) in tap water, river water and industrial water samples from different parts of Khouzesstan, Iran, in all of which dye removal was more than 94. Simplicity of adsorbent preparation, high removal and high adsorption capacity of adsorbent are the main advantages in this method.

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POLLUTION IN THE CHANNEL OF OUED RIGH AND DIEBACK PALM

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Abstract.

Since eighty years ago, the excess water caused by discharges of urban sewage, without pre-treatment joins the ancestral channel of wadi Righ, which is join the natural depression of chott Melghir et Merouane. The lack of an adequate and effective drainage system combined with overexploitation of deep groundwater caused the upwelling of this, which led to an imbalance in the valley. The physico-chemical and water pollution analysis have shown that the quality of these waters is very degraded, very hard, their salt content can exceed 7 g/l of dry residue, of very high salinity, with electrical conductivity up to 26.30 ms/cm, an SAR > 28, a value of T.D.S up to 21 g/l, an BOD₅, COD, and very high TSS content. Combined with the presence of water table near the soil surface, the sterilization of several agricultural areas have been observed, thus canal water is mostly of very poor quality, charged with mineral salts, it is a brackish water of the sodium chloride facies.

Keywords: Algeria – Water – Deterioration - Date palm – Soil - Wadi Righ valley

Modeling of adsorption of two organic pollutants on activated carbon prepared from synthetic waste (tires) and commercial coal: Comparative Study

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Abstract

The development of activated carbon adsorption processes has led researchers to develop coal more specific. Untreated activated carbon adsorbent properties did not particularly interesting. By cons, if it undergoes a special treatment, changes in the physico-chemical surface grant him new features [1].

The aim of the present work two components, the first supplement in an explicit way the fabrication and characterization of a type of highly porous solids are used as activated carbons [2] component. The second component is the comparative study between a commercial activated carbon and activated carbon AC prepared from synthetic waste (tire) CAP in the adsorption of two pollutants (Rhodamine B and Methyl orange). Rhodamine B, and the methyl orange have been described in several research works using other polymer-based precursors and agricultural waste [3, 4].

The results of our studies show that the equilibrium is reached after 5 hours. The pseudo second order is more representative of the two types of coal in modeling the kinetics. The adsorption isotherms are all type L, Freundlich best represents our experimental results with adjustment of the order of 0.99 coefficients.

Keywords

Adsorption, Activated Carbon, Tyres, Rhodamine B, Methyl orange

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Mesoporous Materials Ga doped SBA-15 for Use as Support in Friedel Crafts Acylation: Activity and Stability

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Abstract:

Gallium containing SBA-15 mesoporous materials with Si/Ga =10 and 60 were synthesized using a post and direct treatment procedure with an aqueous solution of Ga(NO₃)₃. The materials were characterized by means of BET, XRD and TEM. It appears that stable Ga-species were anchored to the siliceous matrix of SBA-15 or introduced in the framework via isomorphous substitution, thus generating acid properties in their host material. The catalytic activity of Ga doped SBA-15 materials has been evaluated in the Friedel-Crafts acylation of anisole with benzoyl chloride. In contrast to Ga-samples prepared by post-treatment, in situ GaSBA-15 present a lower stability in the acylation reaction. However, the catalytic results indicate that Ga containing SBA-15 mesoporous materials can be used as versatile and stable acid catalysts for Friedel–Crafts reaction with appropriate behavior depending on their preparation mode.

Keywords: SBA-15, gallium, supported SBA-15, Acid catalyst, Friedel–Crafts

EQUILIBRIUM AND KINETIC ADSORPTION STUDY OF A ANIONIC DYE BY ACTIVATED CLAYS

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Abstract

Textile and tannery effluents are two of the most polluting industrial wastes, and the problems of treatment and disposal of such wastes require much attention. The presence of dyes in aqueous effluent such as in river stream can be noticed easily because dyes are colored and highly visible. Certain amounts of dyes are lost in the manufacturing processes and their effluents have to be treated carefully before discharge.

This research involved the efficient adsorption of anionic dye Derma Blue R67 used in tanning industry on local natural and treated clays; DD3 and KT2, a low-cost material abundant which Algeria possesses estimated at millions of tons, in the East, and that need to be valorized. The kaolins before and after treatment were characterized by chemical analyses (XRF), X-ray diffraction, Scanning Electron Microscopy (SEM) to obtain information about their structure and surface texture. The adsorption kinetics was investigated using the parameters such as contact time, amount of clay, pH, initial dye concentration and effect of temperature. The adsorption amount of Derma Blue R67 dye on local kaolinite clays exceeds 1.8 mg/g observed after 40 to 80 min.

The adsorption of Blue Derma R67 on DD3 kaolin can be explained by the pseudo second- order kinetic model and on KT2 can be explained by the pseudo second- order and pseudo first order kinetic model.

Key words: Kaolin, DD3, KT2, acid activation, anionic dye, adsorption kinetics.

PREPARATION CHARACTERIZATION AND APPLICATION OF GOLD NANOPARTICLES STABILIZED IN ACID-ACTIVATED MONTMORILLONITE

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Gold nanoparticles (AuNPs) were prepared by first $[\text{AuCl}_4]^-$ reduction by sodium borohydride followed by Au^0 -nanoparticles stabilization in acid-activated montmorillonites. The AuNPs stabilized in montmorillonite were tested as catalysts in 4-nitrophenol reduction with NaBH_4 .

Powder X-ray diffraction (XRD), FTIR, TEM, N_2 adsorption and UV-visible spectroscopic analyses were carried out to characterize both montmorillonite and the nanocomposite Au^0 -montmorillonite. TEM, and X-ray diffraction revealed a Au^0 -nanoparticles formation.

The results show that the mean diameters of gold particles are below 5 nm when the gold loading is lower than 2 wt.%. An increase of the amount of the gold precursor results in agglomeration of gold nanoparticles. The reduction reaction of 4-nitrophenol into 4-aminophenol with NaBH_4 catalyzed by our Au^0 -montmorillonite catalyst exhibits remarkably a high activity with time of total conversion of 4 min.

Keywords: Gold, nanoparticles, 4-nitrophenol, Acid-activated montmorillonite

Efficiency improvement of the structure InAsN/GaN for solar Cells applications

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Abstract: The energy of the solar spectrum extends from 0.5 to 3.5 eV, it is a rather wide spectrum to be exploited by a single semiconductor, so the idea is to use alloys composed of four elements chemicals of different gap order to absorb the maximum of the solar spectrum. In this work, we were interested about the study of modeling and simulation of a structure based on $\text{In}_{1-x}\text{Ga}_x\text{N}/\text{GaN}$ for photovoltaic applications. This ternary alloy who is an III-V semiconductor presents important characteristics especially its bandgap energy, thus the enhancement of the absorption of photons with wavelengths near to red. We had also studied a different parameters characterized the solar cell which served us to calculate the efficiency of photovoltaic conversion. He studies of structures that allowed us to produce structures for solar cells based on multi-junction quantum well and quantum dots.

Keywords: materials, semiconductor III-V, solar cell, optoelectronics

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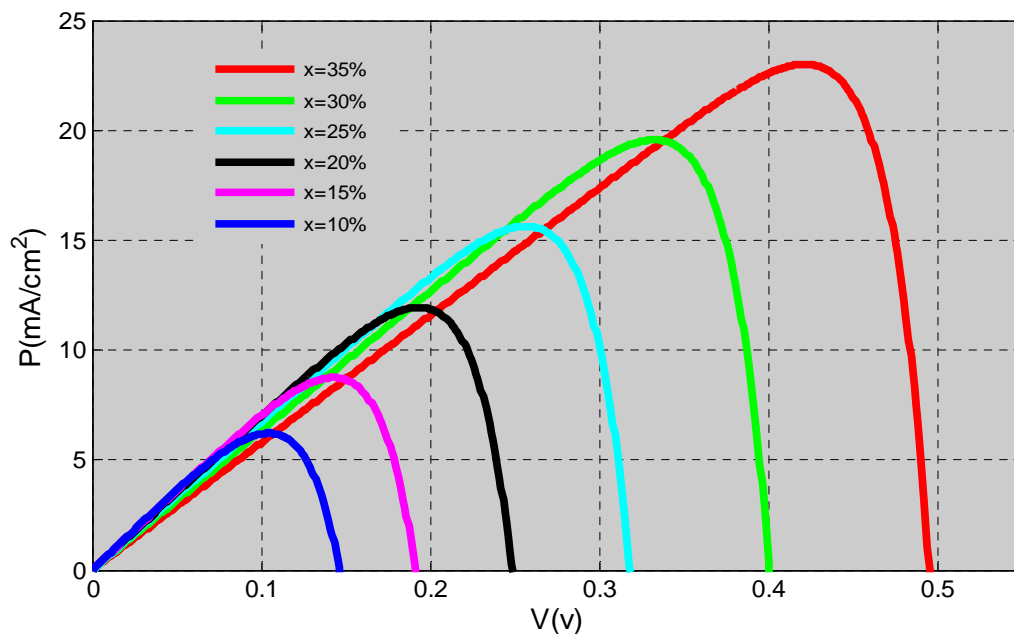


Fig.1 variation of the power in function of the voltage

Cytotoxicity reduction as a main challenge on gold nanorods synthesis using seedless silver-assisted method

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Abstract: Gold nanoparticles (AuNPs) are considered as one of the most promising agents for medicine due to their exceptional qualities. They are being investigated as adept with great potential for targeted drug delivery, enhancing effects of thermal therapy, contrast agent etc. (Lohse and Murphy, 2013). Specifically, gold nanorods (AuNRs) are characterised by the surface plasmons tunable with their size and strong affinity for hydrogen, and thus also for biologically important functional groups such as -SH, -NH₂. Due to the specific and unique properties, it makes a perfect candidate mainly for cancer therapy out of them. There are several problems that are necessary to be solved in the AuNRs preparation. A big task is to prepare the biocompatible nanostructures which are all uniform and reproducible in a given size. Mainly the AuNPs toxicity complicates their medical *in vivo* applications. We have focused on the suitable techniques in protocol using seedless silver-assisted method and further surface modifications for the purpose of alleviating the toxicity (Jana *et al.*, 2001). The influence of three basic reagents concentrations, namely of chloroauric acid (HAuCl₄) and silver nitrate (AgNO₃) in growth solution and the added seed on the final product was investigated in combination with different solvents and surfactants. The physical NPs properties were evaluated and compared with commercial NPs. The main interest was kept on cytotoxicity, which was determined on human ovarian carcinoma cells A2780 via MTT test (Mosmann, 1983). A significant differences in cells viability caused by various parametres (NPs, exposure time, concentration etc.) were observed.

Keywords: gold nanorods, seedless silver-assisted method, biomedical applications, cytotoxicity, MTT test

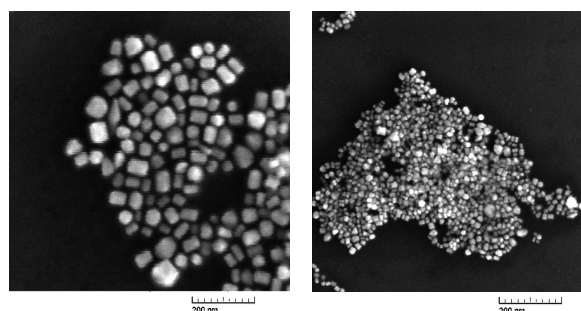


Figure 1: SEM images show how the variability in protocol influences the final physical gold nanorods properties and consequently affects the gold nanorods cytotoxicity

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