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Workshop on

Nanotechnology Applications in Energy, Environment and Health: Benefits and Potential Risks

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Mosto Bousmina

(EuroMed University-Fes, Academy of Sciences & Technology-Morocco)

Prof. Bousmina is the President of the Euro-Mediterranean University of Fez-Morocco, Chancellor of the Hassan II Academy of Science and Technology-Morocco, and President of the Network of African Academies of Sciences (NASAC). He is member at large of the Polymer Processing Society, Member of the World Academy of Sciences, and of the African Academy of Sciences. He acts as Editor-in-Chief of World Research Chemistry Journal, Co-Editor of the Journal of Polymer Engineering, and Associate Editor for the Journal of Nanoscience and Nanotechnology, Regional Editor of Recent Patents on Nanotechnology.

From to 2008 to 2011, he was the Director General the Institute of Nanomaterials and Nanotechnology (INANOTECH), Morocco. Before that he was Professor and the holder of the Canada Research Chair on Polymer Physics and Nanomaterials at Laval University, Quebec-Canada, vice-President of the Canadian Society of Rheology. He acted also as president of the Quebec Society of Polymers (SQP), Director of SPE (Society of Plastic Engineers: Quebec section), Chair of NSERC evaluation committee (chemical and metallurgical engineering section 4). His important contributions are in physics of polymeric multiphase systems, and nanomaterials.

Vincent Bouchiat

(Université Grenoble Alpes, France)

Vincent Bouchiat is a director of research at Neel Institute at National Center of Scientific Research (CNRS-Grenoble) in France. He received his education at the School of Physics and Chemistry of Paris and at the University Pierre & Marie Curie. He then prepared his phD in the Quantronics Group of CEA-Saclay on the study of Quantum Coherence in superconducting devices. In 1997, He was appointed as a permanent research fellow at CNRS at the University of Marseille where he proposed new methods of miniaturizing quantum devices and SQUIDs using Scanning Probe Microscopy and carbon nanostructures. He moved to the low temperature lab of Grenoble in 2000 where efforts were directed towards the interfacing of molecular devices and Graphene with superconducting electrodes. He is currently orienting his research on biomedical applications of 2D materials. He was a visiting professor at Miller Institute at the Physics department of UC Berkeley during the academic years 2007-2008. He co-authored more than 70 peer-reviewed papers and hold 7 patents.

Pedro Serena

(Consejo Superior de Investigaciones Científicas, Spain)

Dr. P.A. Serena obtained his Ph.D. in Physics from the Universidad Autónoma de Madrid. Currently he is researcher at the Madrid Materials Science Institute (ICMM) of Spanish National Research Council (CSIC). He has been working in several projects dealing with the electronic transport and mechanical properties of several types of nanostructures. He is co-author of 95 articles published in international journals, as well as more than 85 articles in scientific policies, technology transfer and science dissemination. He was co-coordinator (2000-2005) of the NanoSpain Network, coordinator of the Nanotechnology Strategic Action of the Spanish Ministry for Science and Innovation (2007-2011), coordinator of the Materials Area at CSIC (2012-2014). Since 2014 he was designated as Institutional Coordinator of CSIC for the Region of Madrid

Claudio Melis

(University of Cagliari, Italy)

Claudio Melis obtained his master degree in Physics in July 2003 at the University of Cagliari with a thesis on the physics of defects in silicon under the supervision of Prof. Vincenzo Fiorentini. From July to October 2003 C. M. worked as research assistant at the University of Cagliari studying the energetics and diffusion of different dopants on crystalline silicon. In November 2003 C.M. started a PhD at King's College London under the supervision of Dr. Carla Molteni in the field of computational biophysics. C.M obtained his Phd in July 2007 discussing a thesis titled "Mutagensis computer experiments on ligand-gated ion channels". From January 2007 to June 2008 C.M worked as a research associate at King's College London in collaboration with Dr. Carla Molteni. From July 2008 to December 2008 C.M obtained a research fellowships for collaborative visits from the Thomas Young Centre for Theory and Simulation of Materials. From December 2009 to September 2012, C.M. worked as a Post-doctoral fellow at the University of Cagliari in collaboration with Prof. Luciano Colombo. C.M. research focused on the characterization of polymer-based nanohybrids for photovoltaics applications via first principles and classical molecular dynamics simulations. From October 2012 C.M works as an assistant Professor at the University of Cagliari focusing on the atomistic characterization of nanoscale thermal transport for thermoelectric applications.

Najia Komiha

(Faculty of Sciences, Mohammed V University, Rabat, Morocco)

Since 1981, professor Najia Komiha is an Active member of the Laboratory of Theoretical Chemistry at Faculty of Science in Rabat, Morocco. She was head of the Laboratory of Theoretical Chemistry in Rabat 1999-2012, and Vice Dean for research and cooperation in the same faculty during the period 2011-2015. Her research interest concerns environment, atmospheric pollution, astrophysics and chemical reactivity for new molecules invention. Potential Energy surfaces determination and spectroscopic studies. She is also expert in Quantum chemistry methods using: Semi-empirical methods: CNDO, MNDO, AM1, PM3, EHT; Ab-initio methods: Hartree-Fock and post Hartree-Fock calculations; configuration interaction approaches (CASSCF, MRCI) and Coupled Cluster methods DFT.

Abdelkarim ElKaddib

(EuroMed University-Fes- Morocco)

Abdelkrim El Kadib received his Ph.D. in 2004 from the laboratoire d'Hétérochimie Fondamentale et Appliquée de l'Université Paul Sabatier de Toulouse. He worked as a Post Doctoral Fellow at the Université de Pau et des Pays de l'Adour on photocatalysis with supported silica and as an Associate Researcher at the Ecole Normale Supérieure de Chimie de Montpellier (ENSCM) on mesoporous materials and heterogeneous catalysis. He then moved to Queen's University, Canada, to work in the field of cross-coupling catalysis with palladium-supported mesoporous materials before joining NANOTECH-MAScIR in Morocco as an Associate Researcher. Presently, he is Professor at the Euro-Med University of Fez (UEMF), Morocco. His research concerns the synthesis of sustainable organic–inorganic hybrid materials, including biomimetic and bioinspired hybrids, mesostructured organosilicates, and phosphorus-based metal oxide mesocrystals and their application in heterogeneous catalysis, energy conversion, and nanomedicine.

Nicolas Martin

(FEMTO-ST Institute, BESANCON Cedex, France)

Nicolas MARTIN, born in 1970, is full professor of Materials Science in National Engineering School (ENSMM) at Besançon in France. He obtained a PhD in Physical Chemistry from the University of Franche-Comté in 1997 and an habilitation degree (Docent) from the same University in 2005. He was a researcher at the Ecole Polytechnique Fédérale de Lausanne (Switzerland) from 1998 to 2000 in the Physics department. He got a permanent position as Associate Professor at the National Engineering School ENSMM – "Ecole Nationale Supérieure de Mécanique et des Microtechniques in Besançon in 2000. He became Full Professor of Materials Science in 2008. He was a visiting researcher in 2012-2013 at the University of Uppsala (Sweden) where he worked at the Angström Laboratory in the Department of Engineering Sciences, Solid State Electronics. In 2017, he spent a short sabbatical leave in the Universty of Alberta in Edmonton (Canada) to work in the Department of Electrical and Computer Engineering. His research is focused on the physics and technology of metallic and ceramic thin films prepared by reactive sputtering. He is also interested in nanostructuration of coatings prepared by Glancing Angle Deposition (GLAD). He was the head of the MIcro NAno MAterials & Surfaces team (MINAMAS) in the Micro Nano Sciences & Systems (MN2S) research department of the FEMTO-ST Institute for 2008 and 2009. He previously was the Deputy Director of MN2S research department from 2010 to 2014. Nicolas Martin authored or co-authored more than 100 articles in international peer-reviewed journals, 1 patent, 5 chapters in books, 1 ebook, and more than 150 presentations in conferences, workshops and short courses.

Habib Elhouichet

(University of Tunis El Manar, Tunis)

Habib Elhouichet is Professor of Physics at the University of Tunis El Manar, Tunisia. His scientific research interests are in photophysics of semiconductor nanostructures for optoelectronic and photocatalysis applications including lasing materials . He works also on the optic of tellurite and phosphate glasses doped with lanthanides for laser emission and optical amplification. He is the author and co-author of 110 research papers published in peer reviewed international journals. Professor ElHouichet is also very involved in (co-) supervising Master and Ph.D students in his field of expertise.

Faycal Djeffal

(University Of Batna2, Algeria)

Fayçal Djeffal received the M.Sc. degree in electronics, the Ph.D. degree in microelectronics, and the Habilitation degree from the University of Batna, Algeria, in 2002, 2006, and 2007, respectively. He is currently a Full Professor at Department of Electronics, Faculty of Technology, University batna2. His PhD and habilitation work (2002- 2007 at University batna2) was dedicated to investigate the nanoelectronic devices (transistors, sensors and quantum structures) using new approaches like: Soft-computing and NEGF formalisms. As a Full Professor, he joined the Laboratory of Advanced Electronics (LEA) at University Batna2 in 2010 with the aim of creating a research team dedicated to investigate the electrical and optical properties of new materials (graphene, metamaterials, graphitic and SiC) at the nanoscale using new techniques for high-performance and low cost photovoltaic and sensing applications. During this period, several scientific visits to different international institutions (Besancon, Strasbourg, Marseilles, Kyoto, Berlin, ...) have been carried by Djeffal. His present scientific interest goes along two lines: studying new materials, metamaterials and thin film structures under realistic conditions (room temperature), designing new microelectronic devices for obtaining optimal performances and finally to experimental demonstration of highly efficient power transistors, sensors and solar cells for high-performance and low cost photovoltaic applications. He has published more than 150 journal articles and conference papers and author of some books and book-chapters in the field of microelectronics and soft-computing. Moreover, Prof. Djeffal received several scientific awards and international institution fellowship positions.

François Le Normand

(Institut de Physique et Chimie des Matériaux de Strasbourg, France)

Francois Le Normand studied chemistry at the Ecole Supérieure de Chimie de Lyon (ESCIL) where he received his diploma in 1977. In 1986 he was awarded his PhD for his thesis "Role of rare earth in exhaust gas catalysis " by the University of Strasbourg. Since then he has been leading of groups at the former Laboratoire of Catalysis of Strasbourg with strong contribution on the role of rare earth in the exhaust gas catalysis (1981-1989); on the" Nucleation and growth of CVD diamond films at the new IPCMS (Institute of Material Chemistry and Physics) (1989-1999); on the Growth of vertically oriented array of single carbon nanotubes (CNTS) with applications to field emission and the magnetism of the catalytic particles embedded into the CNTs at IPCMS (1999-2010). Since 2010 he has developed a new thematic at ICube/MaCEPV in Strasbourg on graphene and 2D materials with the objectives in photovoltaics to produce transparent electrodes.

Samir Romdhane

(University of Carthage, Tunisia)

Samir Romdhane studied physics at Faculty of Sciences of Tunis, where he graduated in 1989. He did PhD research at Laboratory of Advanced Physics and Quantum Phenomena and received a doctor's degree from Faculty of Sciences of Tunis in 1997. He obtained his habilitation in physics in 2003. His scientific interests deal with the electronic properties of organic conjugated materials and their applications in organic electronics, in particular in the field of solar energy conversion into electric energy. His research activity is mainly focused on the investigation of organic solar cells, with the aim to understand the complex interplay between the chemical structure of materials, their chemical-physical properties and their effects on the performance of solar cells.

Matthias Thiele

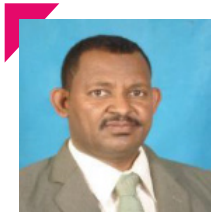
(Leibniz Institute of Photonic Technology Jena, Germany)

Since 2013, Matthias Thiele is a Scientist at Department of Nanobiophotonics in Leibniz Institute of Photonic Technology Jena. He was also Guest researcher at different Institutions such as CIC biomaGUNE San Sebastian(Spain) in 2016, Universidade Nova de Lisboa, Lisbon(Portugal) in 2015, University of Porto Porto (Portugal) in 2014 and 2013, Saclay Institute of Matter and Radiation (France) in 2014, the group of Molecular Electronics and Plasmonics in Nanoscience Center, Jyväskylä (Finland) in 2013 and 2012. During 2011, he was Erasmus student at the Department of Biochemistry in Ege University, Izmir (Turkey). In 2016, he Hold two lectures and gave two practical courses about Nanoparticles, Microfluidics and Biosensing in the practical workshop Biosensing with Plasmonic Nanomaterials, American University, Cairo (Egypt).

Joydeep Dutta

(KTH Royal Institute of Technology Chair, Sweden)

Prof. Joydeep Dutta is the Chair of Functional Materials at KTH Royal Institute of Technology, Stockholm, Sweden. Earlier, he was the Chair Professor in Nanotechnology for Water Desalination and other applications in Sultan Qaboos University from October 2011- September 2015. He served as the Vice President (Academic Affairs), Director of the Center of Excellence in Nanotechnology and Professor in Nanotechnology at the Asian Institute of Technology (AIT), Bangkok, Thailand, whose faculty he joined in April 2003. He completed his Ph.D in 1990 from the Indian Association for the Cultivation of Science, India (Calcutta University). In 1991 and 1992 he did Post Doctoral work at the Electrotechnical Laboratory (ETL, Japan) and at Ecole Polytechnique (France) before moving to Switzerland in 1993 where he was associated with the Swiss Federal Institute of Technology (EPFL), Lausanne, Switzerland until 2003. His broad research interests encompass development of nanomaterials for enhanced treatment of impaired water, desalination, catalysis, solar photocatalysis, biofouling, solar cells, drug delivery, amongst others. From 1997-2001 he worked in technical and managerial qualities in high technology industries in Switzerland before returning back to academia in 2002. Prof. Dutta is an award winning author (Choice award for Outstanding Academic title of 2010 from American Library Association) of the book "Fundamentals of Nanotechnology". He has also written two other text books entitled "Introduction to Nanoscience" and "Introduction to Nanoscience and Nanotechnology" (CRC Press of Taylor and Francis Group LLC). Prof. Dutta has over 200 research publications, with more than 6800+ citations (h-index 42), 11 chapters in Science & Technology reference books, 5 patents and has delivered over 100 invited and keynote lectures. He is member of professional societies and in the editorial board of a few journals and regularly referees articles in international journals.



Abdalla Ahmed Elbashir

(University of Khartoum, Sudan)

Dr. Abdalla Ahmed Elbashir is a professor of Analytical Chemistry, at University of Khartoum, Sudan. Prof. Elbashir received his PhD from University Science Malaysia (USM), at Penang, Malaysia. Prof. Elbashir has been awarded the prize for the best Ph.D. thesis in pure science from (USM). Prof. Elbashir has obtained a Humboldt Research Fellowship for postdoctoral researchers during which he has conducted a research at Duisburg-Essen University (Germany). Prof. Elbashir has published more than 80 papers in internationally refereed journals and participated in more than 25 international conferences in Europe and Asia. Three PhD and 12 master students have been graduated from Prof. Elbashir research group, and currently acting as main supervisor of 5 PhD and 5 master students working in various filed of analytical chemistry.

Ahmed Saad Gomaa Khalil

(University of Cairo, Egypt)

Dr. Ahmed Saad Gomaa Khalil is the founder and the first director of Center for Environmental and Smart Technology (CEST) at Fayoum University. Dr. Khalil awarded the PhD degree (Physics) in 2008 from Max Planck Institute in Germany. He received his B. Sc and M. Sc from Cairo University in 1999 and 2003 respectively. Dr. Khalil was a Postdoctoral associate (2008-2010) at the University of Duisburg-Essen, Germany and a visiting scientist (2010-2011) at IBM Research labs in Zurich, Switzerland. His scientific achievements during his PhD and Postdoc appointments have been published in high ranked journals such as Advanced Materials, Journal of American Chemical Society, Journal of Materials Chemistry, Desalination Carbon, and Journal of Membrane Science. Dr. Khalil has research experience in water desalination, printed electronics and solar energy. Over the last 5 years, Dr. Khalil has succeeded to attract more than 7 Million Euro for his research and teaching activities at Fayoum University. These activities have been done in close collaboration with more than 50 partners from USA, Europe, Asia and the Arab world. Since 2016, Dr. Khalil is the elected member of the Arab German Academy of Science and Humanities (AGYA) in Germany.

Hamza A. Rouabah
(University of Batna, Algeria)

Hamza A. Rouabah received his frist engineering degree in microelectronics in 2001 from the university of Batna, Algeria, follwoed by an M.Sc. degree in microelectronics systems design, and a Ph.D. degree in Nano-Bio-Electronics, from the University of Southampton, UK, in 2005, 2010 respectively. He was a visitor reseracher in Maoud's group at the Univesrity of California Irvine, USA, where he was working the devloppement of new biosensors related devices. He worked also as a postdoctoral research engineering in the national oceangraphy center in the UK. Between 2012 and 2014 he joind the electronics industrial sectror and he worked in both production and R&D depertments. By the end 2014 he joined the univesity fo Batna 2 and he is currently a senior lecturer at the Department of Electronics, Faculty of Technology, University Batna2, where he teaches materials and sensors and micro/nano fabrication related modules. He has joined the Laboratory of Advanced Electronics (LEA) at University Batna2 in 2016wehre his research interests include nanomaterials, design and fabrication of Bio/microsensors and microactuators, fabrication of integrated MEMS and Bio-MEMS.

1RST SESSION: NANOMATERIALS: MEDICAL APPLICATIONS & HEALTH CARE

Biological and biomedical applications of graphene

Vincent Bouchiat
Université Grenoble Alpes, France

We are developing a technology platform that exploits the features of graphene, anatomically-thin layer of pure carbon for its promising perspectives in biomedical applications. Indeed, it has outstanding heat- and electro-conductive properties, but is also providing a biostimulating surface. I will present also the perspective for both academic and industrial developments of this technology. The first-generation of our system is a graphene-based scaffold that looks like a very thin, transparent plaster. I will show results of in-vitro cellular growth (neurons and fibroblast) on graphene-covered glass which show that growth of cells is promoted by the graphene substrate (1). Regarding in-vivo applications, the graphene layer is transferred on a polymer film and its surface is directly put in contact with the wound. We then record its effect on the wound healing. The graphene covered bandages show clear enhancement of cellular growth together with in situ detection of the electrical activity. The specific properties of graphene make it a substrate useful for providing wound dressing enabling a novel wound healing technology that not only has a therapeutic effect (2) but also diagnostic capabilities.

(1) Veliev et al. Biomaterials, 86, pp.33–41 (2016).
(2) http://www.linksium.fr/projet/grapheal/

Nanotechnology: from laboratory to markets, from benefits to risks

Pedro Serena
Consejo Superior de Investigaciones Científicas, Spain

Reserarch in nanoscience was been carried out over the second half of last Century widening our knowledge about the nanoworld. From the beginning of the 21st Century several countries and economical regions boosted the funding of initiatives intended to the transform the basic knowledge generated in the laboratories in practical realizations giving rise to the nanotechnology impulse. Nowadays these strategies and large scale funding provide nanotechnology based products, goods and services. Thousands of components and products are currently commercialized in our markets. In parallel, the euphoria (or hype) of nanotechnology has been cooled down when several important aspects are considered in order to achieve a rational nanotechnology implantation: standarization and regulation issues, international

commerzialization rules, safety issues concerning consumers and workers, environmental aspects. Several activiste organizations have been alerting about possible drawbacks of nanotechnology, requesting major research on possible negative nanomaterials effects, more restrictive regulations and even a nanotechnology moratory. The present contribution will provide an overview of the current situation of such issues emphasizing security and safety aspects as well as recent regulations on nanotechnology applied to food, cosmetic, etc

2ND SESSION: NANOTECHNOLOGY: BENEFITS & APPLICATIONS IN ENERGY

Reducing thermal transport to increase efficiency in thermoelectric conversion

Claudio Melis

University of Cagliari, Italy

The physics of thermoelectric conversion is summarized by the figure of merit ZT= S2Tσ/κ characterizing the efficiency of heat conversion to electricity at temperature T (here, S is the Seebeck coefficient, while σ and κ are the electrical and thermal conductivity, respectively). Energy applications call for high ZT values or, equivalently, for minimal κ. In most systems of current interest, the lattice contribution to κ is largely dominant to the electron one. This motivates the search for new materials with very low lattice thermal conductivity, a situation obtained either by tailoring new chemically complex materials with suitable phonon properties or by nanostructuring more conventional materials so that internal boundaries (phase or grain boundaries maximize phonon scattering. To this aim atomistic simulations, capable of handling large samples and describing accurately phonon dispersions and lifetimes at the nanoscale, could greatly advance our understanding and finally controlling heat transport in complex nanostructured materials. In this talk I will review the most recent advancements obtained by atomistic simulations in the design of specific nanostructures for thermoelectric applications by presenting a series of paradigmatic cases.

CO2 capture and storage by Zeolitic Imidazole Frameworks-A theoretical contribution

Najia Komiha

Faculty of Sciences, Mohammed V University, Rabat, Morocco

The increasing concentration of CO2 gas in the atmosphere is one of the major concerns of the scientific community today. Numerous studies have begun to explore this topic and propose solutions to reduce the high concentration of this greenhouse effect gas. New capture and sequestration technologies have been proposed for that, motivating the search for new materials such as MOF's, ZIF's and other porous solids. This work is a theoretical study using quantum chemistry methods. As Imidazoles are important organic units of the ZIF's, we first consider the interaction of Imidazole and greenhouse effect gas. Selectivity and efficiency of Imidazole on greenhouse effect gas capture and storage are studied then real ZIFs are considered. A large panel of methods are used depending of the dimension of the studied systems and the accuracy needed: the Density Functional Theory (DFT-D3) with Grimme's empirical correction, suitable for dispersion forces description, Möller-Plesset (MP2) theories in connection with cc-pVTZ and aug-cc-pVTZ basis sets and the very accurate explicitly correlated coupled cluster methods CCSD(T)-F12. The adsorption of a carbon dioxide molecule by different sets of zeolitic imidazolate framework materials (ZIF-1 to -4, -6 to -10, and -zni) is examined. We have calculated the interaction energies, the dipole moment variation, and the charge density difference for the different CO2@ZIF structures. Our study shows a strong relationship between the CO2 adsorption energy and the volume of the cavities of the ZIFs: the capture of carbon dioxide depends on the shape and size of the ZIFs pore in which CO2 has been inserted. The physisorption phenomena that govern the adsorption of CO2 molecule require both stacking interactions and hydrogen-like bonding.

From biomass waste to carbon-based nanomaterials

Abdelkarim ElKaddib

EuroMed University-Fes- Morocco

The recent trend witnessed a spectacular rise of carbon molecules (carbenes, allenes, carbon-stabilized low coordination species) and carbon-based materials (fullerene, graphene, carbon nanotubes). Having revealed an hegemonic superiority to their non affordable, cost and toxic metal congeners, sustainable porous carbon-based frameworks constitute prominent contenders for the every-day life technology. Interestingly, biomass is available in enormous quantities in earth and constitutes a unique raw material to construct different carbon–based nano- and micro-architectures. Polysaccharides, for example, are excellent candidates for such strategy owing to a set of advantages including their structural complexity, functionality, metal coordination ability and their self-assembling properties. In this talk, we will focus on how to design novel functional materials from biomass waste (example ified here in by shell-fish waste industry) by exploring the knowledge gained in conventional nanomaterial synthesis. We potentially took benefits from some inherent advantages of chitosan as building blocks to provide an accurate control at the nanoscale level during the synthesis of organic-inorganic hybrid materials.1,2 The hydrothermal or thermal carbonisation ensure polysaccharide transformation to carbon-based framework. This path provides an unlimited library of carbon-based materials. Particularly, functionalized, crystalline graphitic network or fluorescent carbon "dots"- can be rationally designed.

1.A. El Kadib, Chem Sus Chem, 9 (2016) 238-240

2.S. Frindy, A. El Kadib, M. Lahcini, A. Primo, H. Garcia. ACS Catal.,6 (2016) 3863-3869

3RD SESSION: NANOTECHNOLOGY FOR ENVIRONMENTAL ENGINEERING

Tunable architectures of nanostructured thin films: Resulting properties and application as gas sensors

Nicolas Martin

FEMTO-ST Institute, BESANCON Cedex, France

Structuring of thin films is gaining scientific interest since the last decades and the development of new methods of synthesis became a technological requirement. As a result, it is now quite difficult to quantify the right number of processes focused on the fabrication of nanostructured materials. In the well-known race for multifunctional materials, an enhancement of the material behaviors due to the modification of its surfaces or by means of the deposition of thin films appears as an attractive way. This presentation aims at illustrating how functionality of metallic and ceramic thin films sputter deposited can be tuned with a structural approach: the GLancing Angle Deposition (GLAD) [1]. This technique employs oblique angle deposition and controlled substrate motion to form a structure composed of nanometer scaled columns of designed shape. It allows the fabrication of films with a carefully engineered structure at the sub-micron scale. Thus, very original architectures (zigzags, spirals, oriented columns and so on) of the films can be produced, which provide new geometries of the film structure [2-4]. The basic principle of this innovative technique using a fixed and/or mobile substrate will be presented in terms of structural characteristics and surface morphologies. Some behaviors of such thin films will be discussed especially showing the correlations between the dimensions, shapes and geometry of produced architectures and the resulting properties. Finally, potential applications of these structured thin films as gas sensors will be reviewed.

[1] K. Robbie, M.J. Brett, J. Vac. Sci. Technol. A15(3) (1997) 1460-1465.
[2] N. Martin, K. Robbie, L. Carpentier, in: J. Takadoum, Nanomaterials and Surface Engineering, ISTE Ltd., London, 2010, pp. 1-30.
[3] M.M. Hawkeye, M.T. Taschuk, M.J. Brett, John Wiley & Son Ltd., West Sussex, 2014.
[4] A. Barranco, A. Borras, A.R. Gonzalez-Elipe, A. Palmero, Prog. Mater. Sci. 76 (2016) 59-153.

Zn stannate based substrates: Strategies for efficient interfacial charge for photocatalytic activity

Habib Elhouichet

University of Tunis El Manar, Tunis

A facile and efficient one-step hydrothermal approach has been developed to synthesize Zn-2SnO4 nanoparticles/reduced graphene oxide (ZTO/rGO) and Ag@AgCl/ZTO nanocomposites. This approach allows simultaneous reduction of GO and growth of spinel ZTO nanoparticles (NPs) on rGO sheets. The morphology and microstructure characterizations of ZTO/rGO nanocomposites revealed that this method leads to close interfacial contact of ZTO NPs and rGO and efficient dispersion of ZTO NPs on the surface of rGO sheets. The photocatalytic activity of the ZTO/rGO nanocomposite was investigated for the reduction of rhodamine B under visible light irradiation. Compared to pure ZTO NPs, ZTO/rGO nanocomposite exhibited superior photocatalytic activity with a full degradation within 15 min. The ZTO and ZTO/rGO-assisted photocatalytic degradation of RhB occurred via two competitive processes: a photocatalytic process and a photosensitized process. However, the enhanced photocatalytic performance of ZTO/rGO was mainly attributed to excellent electron trapping and effective adsorption properties of rGO. In addition, Ag@AgCl/ZTO nanocomposites were successfully prepared by a hydrothermal method. All the morphogical and the optical analysis confirmed the anchoring of Ag@AgCl on ZTO. The photocatalytic activity of the Ag@AgCl/ZTO nanocomposites, under visible light irradiation, shows an important improvement of the catalytic activity as compared to ZTO solely. The photocatalytic enhancement can be attributed to a plasmonic effect at the interface between Ag@AgCl and ZTO. Thus, the good catalytic performance of the nanocomposites combined with their simple synthesis could provide a facile way to achieve highly efficient photocatalysts.

A novel high-performance self-powered ultraviolet photodetector

Faycal Djeffal

University Of Batna2, Algeria

Recently, new challenges are arisen when incorporating the traditional copper electrical interconnects in chip level communication, including resistive loss, signal attenuation, distortion and the cost overhead [1-2]. Alternatively, optical wireless communication systems (OWCS) are becoming increasingly attractive and can potentially improve the computation speed and decrease the power consumption at long distance communication [3]. However, at very short length scales, the energy consumption of the optical links should be drastically improved in order to make them competitive with their electrical counterparts [4-5]. In this Talk, a new MSM-UV-photodetector (PD) based on dual wide band-gap material (DM) engineering aspect is proposed to achieve high-performance self-powered device. Comprehensive analytical models for the proposed sensor photocurrent and the device Figures of Merit (FoMs) are developed incorporating the impact of DM aspect on the device photoelectrical behavior. The obtained results are validated with the numerical data using commercial TCAD software. Our investigation demonstrates that the adopted design amendment modulates the electric field in the device, which provides the possibility to drive appropriate photo-generated carriers without an external applied voltage. This phenomenon suggests achieving the dual role of effective carriers' separation and an efficient reduce of the dark current. Moreover, a new hybrid approach based on analytical modeling and Particle Swarm Optimization (PSO) is proposed to achieve improved photoelectric behavior at zero bias that can ensure favorable self-powered MSM-based UV-PD. It is found that the proposed design methodology has succeeded in identifying the optimized design that offers a self-powered

device with high-responsivity (98 mA/W) and superior ION/IOFF ratio (480 dB). These results make the optimized MSM-UV-DM-PD suitable for providing low cost self-powered devices for high-performance optical communication and monitoring applications.

1. N. Kannan and M. J. Kumar, IEEE Trans. Electron Devices, vol. 49, pp. 590-597, 2002.
2. S. Manipatruni, M. Lipson, and I. A. Young, IEEE Journal of Selected Topics in Quantum Electronics, vol. 19, pp. 1077-1086 , 2013.
3. D. A. B. Miller, "Physical reasons for optical interconnections," Intl. Journal of Optoelectronics, vol. 11, pp. 155-168, 1997.
4. A. Krishnamoorthy, H. Schwetman, X. Zheng, and R. Ho, Journal Of Lightwave Technology, vol. 33, pp. 889–900, 2015.
5. Chen Sun et al. , Nature, vol.528, pp. 534–538, 2015.

4TH SESSION: NANOTECHNOLOGY FOR SOLAR ENERGY COLLECTION & CONVERSION

Oriented carbon nanotubes and graphene films: relations preparation/properties (electron transport, magnetism)/applications

François Le Normand
Institut de Physique et Chimie des Matériaux de Strasbourg, France

I will illustrate some applications of new carbon nanomaterials like carbon nanotubes and graphene-like films. First I will develop the process of array of oriented single multiwall carbon nanotubes by a catalytic- and plasma-enhanced CVD technique in order to apply directly these systems for field emission and for the magnetism of the catalytic particles embedded into the single carbon nanotubes. Then I will develop our new project on the direct formation of graphene-like layer obtained on a very thin diamond-like carbon film for transparent conducting electrodes (TCE). We will detail different modes of preparation, and the properties of transmission and surface conductivity that yields figures of merit for transparency conductivity comparable or even better than ITO.

Efficiency improvement of nanostructured organic Solar Cells

Samir Romdhane
University of Carthage, Tunisia

Photovoltaic solar energy (PV) is a key technology for the transformation of our energy system, leading to very low carbon emissions and security of supply and contributing to a new, green economy. In combination with other renewables and energy storage, it will enable a sustainable, affordable and reliable energy supply. PV has made impressive progress in terms of conversion efficiency, cost and scale of deployment. Among the new technologies, organic solar cells are an attractive worldwide research subject because they are cheap, thin, lightweight and flexible. These characteristics make the organic solar cells easy to implement and usable for a variety of purposes [1]. One of the most promising solar cells that are having a rapid progression of improvements [2] are made from conjugated polymers and fullerenes in which a large heterointerface is achieved using the so-called bulk- heterojunction (BHJ) morphologies. In this present talk, we will provide the functioning of an organic solar cell. We will show its limits and some key factors to be addressed by researchers to improve its efficiencies. We present a bulk heterojunction (BHJ) solar cell in a standard architecture made of an anthracene containing poly(p-arylene-ethynylene)-alt-poly(p-arylene-vinylene)/1-(3 methoxycarbonyl) propyl-1-phenyl[6,6] and C60 (AnE-PVstat:PCBM) blend. We will show that various parameters can have a distinct impact at the properties and the performance of the bulk-heterojunction solar cells.

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[2] Vasily A. Trukhanov, Vladimir V. Bruevich & Dmitry Yu. Paraschuk.Scientific Reports 5, 11478 (2015).
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Plasmonic Nanomaterials: From fabrication to application

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Plasmonic nanoparticles, e.g. nanoscale particles consisting of noble metals, show high potential as transducer elements in novel optical sensors. The optical properties are based on collective and coherent oscillation of the conduction electrons by irradiating electromagnetic waves. The resulting resonance band (localized surface plasmon resonance [LSPR]) is adjustable in the UV- to near-infrared spectral range and can be defined by the chemical synthesis. The synthesis conditions can determine dimension, material and particle shape, and these parameters represent the main factors for the position of the LSPR and the bulk sensitivity. Therefore, a reproducible synthesis of nanoparticles with defined LSPR is of importance. The sensing principle is based on the strong influence of the surrounding medium's refractive index. Especially, anisotropically shaped particles are especially sensitive to small changes in the medium; therefore, their defined synthesis is in the focus of current developments. In my talk, I will give an overview of the different synthesis techniques for plasmonic nanoparticles and will show possibilities to utilize them for different sensoric applications.

5TH SESSION: NANOMATERIALS FOR CLEAN & SUSTAINABLE TECHNOLOGY

Nanotechnology for sustainable water treatment

Joydeep Dutta
KTH Royal Institute of Technology Chair, Sweden

If the proliferation of today's technologies is any indication of the speed and power of changes in economies across the world, in the near future nanomaterials will lead to an even more dramatic paradigm shift. The next few decades will experience this "sunrise technology" as a

platform for the convergence of diverse technologies and materials resulting in innovative products and processes for the benefit of mankind. In this talk we will discuss about possible strategies to contribute to efforts to save the planet from further environmental problems using nano-functional materials. Ground water pollution due to industrialization and urbanization solicits new ways of removal of unwanted chemicals, biohazardous microorganisms, solid wastes and dissolved gases to be suitable for drinking. In order to address the future water scarcity a combination of approaches including water conservation, recycling, and treatment of impaired water from non-traditional resources to "create" new water needs to be considered. Some of these areas utilising visible light photocatalysis and electrocatalysis will be discussed. Possibilities of prevention of biofouling utilising visible light photocatalytic coatings will also be presented. We will discuss about one dimensional ZnO nanorods epitaxially grown under various conditions on seeded substrates by a low temperature hydrothermal process and its application in removing harmful chemicals and in the prevention of biofouling. We will also introduce a novel capacitive device for water desalination and treatment during this talk.

Applications of nano-materials in water purification

Abdalla Ahmed Elbashir

University of Khartoum, Sudan

Water is an important element to all living organism for sustainable life. Organic and inorganic pollutants are often dangerous for living beings and ecosystem. Therefore, the removal of these pollutants from contaminated water is an urgent need in order to prevent the negative effects on the human health and to the environment. Various techniques have been used for treating the waste water such as solvent extraction, micro and ultrafiltration, gravity separation, evaporation, distillation, reverse osmosis, adsorption, and ion exchange. In recent decade development in nanotechnology and their application in treatment of waste water becoming a major area research. In this paper the application of nanomaterials in water treatment will be discussed.

High Performance Patterned Water Desalination Membranes

Ahmed Saad Gomaa Khalil

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Polyamide thin-film composite (PA-TFC) membranes have been remarkably developed over the last decade towards efficient membranes exhibiting improved performance and extended operating time. Among many suggested strategies, the introduction of the "Super-switching" concept is considered as a new interesting trend. The "super-switching" properties can be specifically adapted to the water desalination membranes via consolidating two different phenomena; "surface micro-patterning" and "double stimuli-responsivity". Here, we present a novel "surface micro-patterning" approach as a promising platform towards novel PA-TFC membranes of superior performance [1,2]. New micro-patterned PA-TFC membranes are successfully fabricated using two microfabrication methods, combined processes of vapor- and non-solvent-induced phase separation micro-molding (PSμM), as well as microimprinting lithography (MIL), followed by a systematic adjustment of the interfacial polymerization conditions. The patterned PA-TFC membranes exhibit superior water permeability, ~2 – 2.4 times compared to the flat PA-TFC membranes, without sacrificing the membrane selectivity. Additionally, a detailed concentration polarization analysis using different membrane orientations, with patterned grooves "parallel" and "perpendicular" to the direction of feed flow, is carried out. The results show the merits of implementing the micro-patterned TFC membranes in promoting the separation performance, especially at high feed concentrations; for which "parallel" orientation is always favorable. Furthermore, detailed experiments have been performed towards the fabrication of "super-switching" desalination membranes based on the coating of the developed micro-patterned PA-TFC membranes with poly(N-isopropylacrylamide) homopolymers and its copolymers with acrylic acid using carbodimide coupling. The results reveal the ability of the newly modified micro-patterned membranes to switch between "super-hydrophilicity" and "super-hydrophobicity" upon changing pH and temperature333. Currently, the fouling resistance of the newly developed membranes is measured using specifically suited dead-end system to highlight the impacts of external stimuli (heating and mixing) on cake-layer formation. The "super-switching" PA-TFC membranes are implied to be a promising candidate for sustainable water desalination technology.

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Theuse of new design based on 3D electrodes structure to manipulate small quantities of liquids for biomedical applications

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In biomedical engineering technology, pumps for handling extremely small fluid amounts become more and more important. Such pumps can be made using MEMS microsystems, where these microsystems for biological analysis routinely use solid-state electrokineticmicropumps. AC-electrokinetic pumps and in particular the AC-electroosmosissubcategory can be used to move fluids using planar electrodes [1], which induce electrical forces on the fluid. However, planar electrodes have limited pumping capability. An alternative design based on 3D-electrodes which presents the transition from planar microelectrode arrays to planar with High Aspect Ratio (HAR) conductive pillars in order to increase the surface area of the electrodes. The physical mechanism of AC electrosmosis is the motion of induced Electrical Double Layers on the electrodes driven into motion by the electric field generated by the electrodes. Since AC electrosmosis is a surface driven effect, increasing the surface area in-

creases the power coupled into the fluid movement. By taking the channel volume and filling it with conductive pillars[2], the surface area therefore increases, but the volume remains the same, increasing the drive per unit volume [3]. This will have the effect of increasing the pressure generated by the pump. In this work the fabrication techniques were used to construct large dimensions of high-aspect-ratio carbon pillars made out of pyrolyzedPolymer (SU-8) using Carbon-MEMS process is explained. Also the improvement in pumping using the 3D electrodes is highlighted m where carbon electrodes successfully generate local fluid and drive fluid, and the new 3D-AC-electroosmosis micropump design has shown an increase of 5 times in fluid flow to previous planar electrodes design.

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