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Cambridge, UK, February 21-23, 2009

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Preface

This year the 1st WSEAS International Conference on NANOTECHNOLOGY (NANOTECHNOLOGY'09) was held in the University of Cambridge. The Conference remains faithful to its original idea of providing a platform to discuss theoretical and applicative aspects of nanomaterials, nanoparticles and colloids, nanomedicine, molecular self-assembly, nanoelectronics, molecular electronics etc. with participants from all over the world, both from academia and from industry.

Its success is reflected in the papers received, with participants coming from several countries, allowing a real multinational multicultural exchange of experiences and ideas.

During this last year we witnessed the growth of the European Union interest in nanotechnology. This is an additional proof that it is seen not only as an exciting research area but also as technologies that may solve current European citizens' concerns with several practical problems.

For a discipline which is central to research and also to industry, and which generates interests not only among academicians but also among large companies and government departments and agencies, it is important to look at the market and at its movements.

A Conference such as this can only succeed as a team effort, so the Editors want to thank the International Scientific Committee and the Reviewers for their excellent work in reviewing the papers as well as their invaluable input and advice.

The Editors

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Plenary Lecture 1

Field Assisted Processing of Polymer Nanocomposites with Functionalized Carbon Nanotubes and Nanofibres

Professor Jose M. Kenny
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Abstract: Light nanocomposite materials with exceptional mechanical and electronic properties can be made using different type of reinforcements and polymer matrices. In particular, carbon nanotubes (CNT), and more recently Carbon nanofibres (CNF) have been studied extensively because of their exceptional mechanical and electrical properties, yet their practical and extensive use in commercial materials is still missing. The utilization of CNTs and CNFs as reinforcement to design novel composites has been object of many different approaches in the last 10 years; however, there is a lack of a knowledge based approach to achieve the nanostructuration level required to optimize the CNT(CNF)/polymer composite performances.
Currently, carbon nanoobjects are incorporated within the polymer matrix by mixing into the polymer, dispersion in solution or melt processing. However, these methodologies present several critical issues as for example the non-uniform dispersion of nanoreinforcements within the polymer matrix and the lack of control of the alignment or orientation of CNTs and CNFs in the resulting composites. Generally, it is difficult to disperse well a relative high concentration of these nanoobjects into the polymer precursors because of the viscosity of the polymers and the entanglement of the nanotubes.
The challenge for the next future is to get innovative polymer composites filled with CNTs and CNFs in order to obtain nanostructured materials with tailor made properties. For example, the isotropic conductivity of the composites is not necessary in some cases. For instance, it is demanded that the electron charge can penetrate the antistatic shielding film as soon as possible. The conductivity perpendicular to the film surface should be as high as possible but the lateral conductivity is not important—perfect conductivity along one axis is enough to satisfy the application.
Our goal is to investigate the effects of electric and magnetic fields on the physical properties of nanotube based nanocomposites under static loading conditions. We report here our results for different matrices: poly(methyl methacrylate), epoxy systems, block copolymers loaded with carbon nanotubes and carbon nanofibres. The influence of orientation on the electrical anisotropy as well as the role played by the magnetic field on the rheological properties is also reported. These results provide an initial understanding of how electric and magnetic fields can be used to control the bulk physical properties of such nanocomposites.

Brief Biography of the Speaker: Professor Jose M. Kenny was born in 1953 in Buenos Aires (Argentina), where he got his PhD in Chemical Engineering from the University of South (Bahia Blanca). He is currently Full Professor of Material Science and Technology at the University of Perugia, where he also teaches Polymer Technology and Materials Nanotechnology. Moreover, Prof. Kenny is the Director of the International PhD Program on Materials Nanotechnology coordinated by the University of Perugia in collaboration with several European Universities and is the Director of the European Master on Polymer Nanotechnology organized by the University of Perugia. Both programs are supported by the European Network of Excellence "NANOFUN-POLY" coordinated by Prof. Kenny through the Italian Consortium on Materials Science and Technology (INSTM). Recently, Prof. Kenny has been nominated President of the European Centre on Nanostructured Polymers legally constituted in Florence with the support of 12 European Research Centres (www.ecnp.eu.org).
During his career Prof. Kenny has been visiting and research professor in the following universities: University of Naples (1984-1991), University of Connecticut: (1989) University of Washington (1990), Washington University of Saint Louis (1991). He has published more than 300 papers in the scientific literature on the following subjects: mathematical modelling of the processing of composites and polymers, materials for aerospace applications and automotive applications, mathematical modelling of reactive processes, interfaces and surface treatments on polymeric, metallic, ceramic and composite materials; nanotechnologies of polymeric materials, processing and characterization of carbon nanotubes and of their polymer nanocomposites. Moreover, Prof. Kenny has directed

more than 100 theses in Materials Engineering and 15 PhD theses on Industrial Engineering and Materials Nanotechnology.
Prof. Kenny has coordinated several Italian and international research projects is member of several scientific societies and is currently Past-President of the SAMPE Europe (Society for the Advancement of Material and Process Engineering) and Vice-president of SAMPE Italy. Recently, Prof. Kenny has been elected member of the Board of the Italian Industrial Association of Composite Materials.

Plenary Lecture 2

Nanotechnology and Heterogeneous Catalysis

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Abstract: Catalysis is the process in which the rate of a chemical reaction is increased by means of a chemical substance known as a catalyst.Catalysts can be either heterogeneous or homogeneous, depending on whether a catalyst exists in the same phase as the substrate. Biocatalysts are often seen as a separate group. Heterogeneous catalysts are those which act in a different phases than the reactants.. Diverse mechanisms for reactions on surfaces are known, depending on how the adsorption takes place (Langmuir-Hinshelwood and Eley-Rideal). Heterogeneous catalysts are typically “supported,” which means that the catalyst is dispersed on a second material that enhances the effectiveness or minimizes their cost. Nano is a Greek prefix which signifies a "billionth".An atom is smaller than a nanometer, but a a molecule is more -A dimension of 100 nanometers is important in nanotechnology, because under this limit one observes new properties of matter, primarily due to the laws of quantum physics..So catalytic properties could benefit from the synthesis of nanostructured material not through the preparation of nanoparticles with high surface to volume ratio and narrow size distribution but also through the possibility to produce nanoparticles with well defined morphology and surface structure. Nano-materials are more effective than conventional catalysts for two reasons. First, their extremely small size (typically 10-80 nanometers) yields a tremendous surface area -to volume ratio. Also, when materials are fabricated on the nanoscale, they achieve properties not found within their macroscopic counterparts. Both of these reasons account for the versatility and effectiveness of nano-catalysts.
A lot of researches have been done on the application of nanoparticles in heterogeneous catalysis process , some of which and the state of art one will be reviewed in this lecture. Iso-paraffin production on nano-porous catalysts composed of zeolite, nano-porous Al2O3 and Ni-Mo/aAl2O3 showed that the catalyst composed of MFI zeolite selectivity produces propane and that composed of BEA zeolite can selectively produce isobutene whereas that composed of USY zeolite can selectively produce iso-paraffins in gasoline fractions. Pt/MgO catalysts were prepared by using wet impregnation method. Partial Oxidation of Methane (POM) to synthesis gas revealed that Pt particles have the size of less than 10 nm, the size of the support MgO is about 50–200 nm. Nanostellar has filed five broad patent applications for low cost nano catalysts that can be used for gasoline engine three-way catalyst, lean-burn diesel engine catalytic materials, fuel cell proton exchange membrane assemblies, and for the chemical and petrochemical industries. The low temperature nano-catalysts studies for water gas shift reaction showed that Au and Cu nanoparticles supported on the oxides, such as CeO2 and TiO2. display higher activity than the bulk materials and commercial catalysts. Remarkable selectivity is achieved in the cleavage of benzyl ethers using ball-shaped palladium nanocatalysts.

Brief Biography of the Speaker: Karim.H.Hassan, Assistant professor in chemistry department, college of science, university of Diyala, Iraq. B.Sc in chemistry and M.Sc in physical hemistry, college of science, university of Baghdad, department of chemistry in 1983 with thesis name: Determination of half-wave of CoQ0 in aqueous and organic media with different concentrations, Ph.D in physical chemistry, university of Reading UK, 1990 with thesis name: Absorption and laser induced fluorescence spectra of some aromatic molecules.1977-1980 assistant chemist in scientific research council of Iraq.1985 having training coarse in Hungary about petroleum testing and catalysts.1983-1986 assistant researcher in scientific research council of Iraq, petroleum research centre, refining department. 1986-1991 participate in all the southern universities spectroscopy group meetings in the UK by papers. 1986-1991 participate in all the high resolution spectroscopy group meetings and conferences in the UK by papers.1991 participate in the spectroscopy meeting in the West Germany by posters.1991-2003 ministry of science and technology and ministry of industry as head of department of catalysts and material.1993-2003 lecturer and consultant in laser institute for postgraduate studies in university of Baghdad in fine powder production using laser

and laser induced reactions, 1993-till now, being a member of the publishing committee of Iraqi journal of .2000-2003 lecturer in chemistry departments of the college of science, college of education in university of Anbar and in university of Al-Mustansiria of Iraq and also lecturing in college of engineering of Iraq and laser institute for postgraduate studies. The courses being teached are quantum chemistry, surface chemistry and catalysis, industrial chemistry , petrochemicals, reactors, laser in chemistry and spectroscopy, analytical chemistry, nuclear and radiation chemistry. 2004-2006 lecturer in chemistry department , college of science of university of Diyala in Iraq. 2006-2008, head of chemistry department , college of science of university of Diyala in Iraq.35 published paper in national and international journals, participation in 16 scientific chemical national and international conferences, supervising and examining about 30 M.Sc. and Ph.D students in chemistry and chemical engineering.

Plenary Lecture 3

Electrodynamics of Carbon Nanotubes: Principles, Models, Device Applications and Open Questions

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Abstract: A great progress has been achieved during last two decade in the synthesis and fabrication of different nanostructured artificial materials with fascinating mechanical, electronic and optical properties irreducible to properties of bulk media. Accompanied by the impressive parallel development of the characterization techniques and measurement instrumentation, this process necessitates the revision of traditional concepts of physics and chemistry of condensed matter, adapting them to peculiarities of the nanoworld and significantly extending our knowledge of the nature of solids and our capabilities to control their properties. Signalized by the prefix nano- these peculiarities define the development of a variety of new scientific and technological branches, such as nanomechanics, nanoelectronics, nanooptics, nanophotonics, nanosensorics, etc.
Following this general trend, a research discipline – nanoelectromagnetics – is introduced as a synthesis of macroscopic electrodynamics and microscopic theory of electronic properties of different nanostructures. The approach is exemplified by carbon nanotubes (CNTs) and briefly touches upon other nanocarbon forms.
The method of effective boundary conditions is shown to be a universal tool for the study of electrodynamic problems of nanotubes. A set of physical effects, which emerge from the interaction of light with CNTs is described. Linear electrodynamics of nanotubes, nonlinear optical effects in nanotubes and foundations of quantum electrodynamics in nanotubes are discussed. A strong slowing down of surface waves in CNTs is demonstrated and the concept of nanotube as a surface wave nanowaveguide in the infrared and terahertz range is introduced. Theoretical analysis of the scattering pattern and the absorption cross-section of a single-walled finite-length CNT, multi-wall CNT and CNT bundle is presented. Comparison with experimental results is carried out allowing qualitative physical interpretation of low-frequency (far-IR and terahertz) absorption band observed in experiments. Potentiality of CNTs as interconnectors and transmission lines is demonstrated. Antenna properties of single- and multi-walled CNTs and CNT bundles are described and the thermal radiation of isolated CNT is shown to be strongly different from the black-body radiation allowing the thermal antenna concept. Potentiality of CNTs for the IR photothermolysis of living cells is discussed. Strong local field enhancement is predicted to be inherent to metallic CNTs in the near-field zone providing necessary mechanism for far-IR and terahertz near-field optics. The idea of the CNT as monomolecular analog of the free electron laser is proposed and discussed. The formalism of electrodynamics of lossy dispersive media is applied to the problem of spontaneous radiation of an excited atom in the carbon nanotube. Prospective problems of electrodynamics of CNTs are discussed.

Brief Biography of the Speaker: Professor Sergey A. Maksimenko was born in Belarus in 1954. He received a M.S. degree in physics of heat and mass transfer from Belarus State University, Minsk, in 1976; a Ph.D. degree in theoretical physics from Belarus State University in 1988; and a Sc.D. degree in theoretical physics from the Institute of Physics, Minsk, in 1996. He is currently a Head of Laboratory of Electrodynamics of nonhomogeneous media at the Institute for Nuclear Problems at Belarus State University, Minsk, Belarus. He also teaches Physics of Nanostructured Materials at the BSU physical department. He has authored or coauthored more than 150 conference and journal papers. In 2003, 2004, and 2006 Prof. Maksimenko co-chaired Int. Conference “Nanotubes and Nanowires” as a part of SPIE's 48th Annual Meeting, 2003, San Diego, Int. Conference “Nanomodeling” as a part of SPIE's 49th Annual Meeting, 2004, Denver, and Int. Conference “Nanomodeling II” as a part of SPIE’s Optics & Photonics, 2006, San Diego, and Belarus-India joint seminar on Nanoscience and Nanotechnology, 2005, Hyderabad, India. He is the associated editor of the SPIE’s Journal of Nanophotonics. His current research interests are electromagnetic wave theory and electromagnetic processes in quasione- and zero-dimensional nanostructures in condensed matter.

Plenary Lecture 4

Nanotechnology Research Efforts in Mexico

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Abstract: In this plenary talk I will describe the research activities of about fifty Mexican nanotechnology research groups, comprising 300 researchers, and I will explain the need for governmental intervention in order to attain the objective of a Mexican Nanotechnology Initiative. In 2006 Mexican Council of Science of Technology funded several research groups to develop projects related to a Mexican National Initiative and in 2009 significant funds will be dedicated to technnological innovation in Mexican companies as well as technological invention derived from academic research. Proper screening of this funds may improve the production of Mexican patents and the development of large research networks all along Mexico where Nanotechnology research has been done mainly by public universities. Nanotechnology research groups in Mexico typically have five members and are devoted to a wide range of research subjects. Nanotechnology Laboratories have been founded in several Mexican States, using computational techniques, nanomicroscopy and chemical synthesis to develop new materials as well as new theoretical approaches to understand nanotechnology properties. Other Mexican nanotechnology research groups study the social and environmental impact of nanotechnology. The size frequency distribution of these research groups follows a power law in agreement with a model for social interaction although there are yet no signs of an institutional organization of these research groups which might lead to the creation of a Mexican Nanotechnology Initiative. Besides, it is also difficult to know which companies facing major economic hard times will have enough strength to complete the research and development tasks required to innovate. This will demand a proper selection of the companies funded and a careful screening of the funds devoted by CONACYT for innovation in Mexican companies.

Brief Biography of the Speaker: Armando Barranon was born in Mexico City. B.Sc. in Mathematical Physics, Instituto Politecnico Nacional, Mexico City, 1986. M.Sc. in Applied Statistics, The University of Texas at El Paso, 1989. Dr. in Philosophy, U. La Salle, Magna Cum Laude, Mexico City, 2004. M.Sc. Physics, Instituto Politecnico Nacional, Mexico City, 2005. Dr. in Physics of Materials, Instituto Politecnico Nacional, Mexico City, 2008. Postdoctoral Fellow, U. Zacatecas, Mexico, 2008.

He is Full Professor at Department of Basic Sciences, Universidad Autonoma Metropolitana-Azcapotzalco, Mexico City. Research interests include Nuclear Physics, Computational Physics and Philosophy of Technology. In 2007, Dr. Barranon founded the Nanoeducation Seminar at UAM-Azcapotzalco.

Dr. Barranon is member of the Mexican National Research System, member of American Physical Society, Sociedad Mexicana de Fisica, Sociedad Mexicana de Matematicas, Sociedad Mexicana de Termodinamica, Sociedad Mexicana de Historia de la Ciencia y la Tecnologia, among others. Nowadays, Dr. Barranon is on sabbatical leave at University of Texas at El Paso, funded by the Mexican Council of Science of Technology and UAM-A.

Plenary Lecture 5

Synthesis and Applications of Some Nanostructured Materials

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Abstract: Nanostructure materials possess novel properties characteristic of neither the molecular nor the bulk solid state with sized dependent behavior. Nanoporous materials can be synthesized either by bottom-up technique or top-bottom technique. The resultants, nonoporous materials, are characterized by well-defined pore and/or cavities size in nanometer scale, with unique molecular sieving capabilities and ultrahigh surface area: suitable as hosts and templates for fabrication of nanoscale devices and nanomaterials. Supported nanoporous materials play a very important role in catalysis. We will describe synthesis and characterization of improved heterogeneous catalysts for ring-opening polymerization based on metal-substituted hexagonal nanoporous silica. We will discuss the fundamental principle for designing synthesis and characterization of nanoporous adsorbents for environmental remediation. For example, lead ions in soils and stormwater run-off from small arms firing range (SAFR) is a concern of national proportion. Various adsorption technologies have been studied to solve the problem of lead species releases to the environment. Also, we will present a study to support worldwide research efforts to obtain drinking water with arsenic levels below 10 part per billion (ppb), using different adsorbents modified with iron species. Using template technique, we synthesized carbon nanotubes and novel multi-wall metal oxides nanotubes, such as metal oxides like hafnium oxide (hafnia, HfO2), zirconium oxide (zirconia, ZrO2) and semiconducting zinc oxide (ZnO). These metal oxide tubes are important materials that can be used as gas sensors, catalysts, opto-electronics, and high-k dielectrics in microelectronics.

Brief Biography of the Speaker: Dr. Tarek Abdel-Fattah holds a B.S. and M.S. degrees in Chemistry from Alexandria University and a Ph.D. degree in Inorganic and Materials Chemistry from Northeastern University, Boston. Currently, he is an Associate Professor of Chemistry and the Director of the Applied Research Center at Christopher Newport University. He was the Past President of Sigma Xi Tidewater Chapter of Virginia 2004-2005 and currently holds the Program Chair position of the chapter. Also, he is the chair elect for the American Chemical Society (ACS) for the Hampton Road section 2006-2007. He has published over 20 papers, 2 patents and over 50 presentations in national and international meetings. He has been awarded First Prize from the Physical Sciences Division of the American Association of Advancement of Science (AAAS). He has been awarded twice the American Association for Educational Engineering (ASEE) award of the summer faculty fellowship program at NASA Langley Research Center. He is the recipient of the NASA Faculty Fellowship Certificate of Recognition in different projects concerning nanotechnology for aerospace applications. He was a Christopher Newport University Teaching Fellow 2003.

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