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Advanced Research in Physics and Engineering

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Proceedings of the 2nd WSEAS International Conference on Nanotechnology (NANOTECHNOLOGY '10)

Proceedings of the 5th WSEAS International Conference on Optics - Astrophysics - Astronomy (ICOAA '10)

Proceedings of the 1st WSEAS International Conference on Plasma- Fusion - Nuclear Physics (IPLAFUN '10)

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Preface

This year the 2nd WSEAS International Conference on NANOTECHNOLOGY (NANOTECHNOLOGY '10), the 5th WSEAS International Conference on OPTICS - ASTROPHYSICS - ASTRONOMY (ICOAA '10) and the 1st WSEAS International Conference on PLASMA- FUSION - NUCLEAR PHYSICS (IPLAFUN '10) were held at the University of Cambridge, UK, February 20-22, 2010. The conferences remain faithful to their original idea of providing a platform to discuss nanomaterials, nanoparticles and colloids, nanomedicine, molecular self-assembly, nanoelectronics, molecular electronics, nanolithography, molecular nanotechnology, microscopes and other devices - microscopy, optics, astrophysics - astronomy, advances in nuclear power technology development, fusion device engineering, nuclear and plasma sciences, radiation physics, theoretical and computational nuclear physics etc. with participants from all over the world, both from academia and from industry.

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

The accepted papers of these conferences are published in this Book that will be indexed by ISI. Please, check it: www.worldses.org/indexes as well as in the CD-ROM Proceedings. They will be also available in the E-Library of the WSEAS. The best papers will be also promoted in many Journals for further evaluation.

Conferences such as these 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

Functionalized Nanostructured Silica-Based Materials in Electrochemistry

Professor Alain Walcarius
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Abstract: Nanocomposites made of silica-based organic-inorganic hybrid materials displaying a regular mesoporous structure at the mesoporous level, which can be functionalized with appropriate organic groups, are of particular interest for various applications [1]. They indeed provide a unique environment with high accessibility to numerous active centers located in an ordered and mechanically stable structure. Such nanoreactors have recently appeared to be very promising electrode modifiers [2] as they ensure fast mass transport processes, which are often rate-determining in electrochemistry. The aim of this lecture is to highlight and discuss some recent achievements performed at the confluence of these nanostructured materials and electrochemistry, by focusing mainly on thin-film devices.

Three complementary directions will be considered. The first one relies on the usefulness of electrochemical techniques to get information on mass transport through ordered mesoporous films, with special emphasis on the influence of the mesostructure type and the nature of the redox probe on these processes [3]. The second aspect concerns a feedback of materials science to electroanalysis, by exploiting the attractive and sometimes unique properties of mesoporous (organo)silica films on electrodes to improve their sensitivity in comparison to the non-ordered ones, when applied as voltammetric sensing devices [4]. The third domain is related to the use of electrochemistry to prepare thin films of sol-gel-materials via a novel electrochemically-driven deposition method [5], which implies a local electrochemical tuning of pH at the electrode/solution interface to induce co-condensation of the precursors in a controlled way [6]. Even more interesting is the extension of this approach to the preparation of ordered and oriented mesoporous films with mesopore channels oriented perpendicular to the solid surface [7], which has proven to be very difficult by other ways [8]. The method combines the electrochemically-driven self-assembly of surfactants at solid/liquid interfaces [9] and the above electro-assisted generation process to produce sol-gel films [6], leading to perfect alignment of the nanoporous structures normal to the electrode surface [7]. Both preparation and characterization of the oriented mesoporous thin films will be described [10], as well as their functionalization in order to be applied in the field of electrochemical sensors [11]. Such electrochemical nanotechnology is expected to be useful in many other applications.

Brief Biography of the Speaker:
Alain Walcarius received his Ph.D. from the University of Namur (Belgium) in 1994. After a postdoctoral stay in the Joe Wang group in New Mexico State University, he joined the CNRS (France) as a Research Associate. He is currently Research Director in the Laboratory of Physical Chemistry and Microbiology for the Environment (Nancy, France) where his analytical and electroanalytical chemistry group works in the area of reactions at solid/liquid interfaces. Among his actual research interests is the intersection between the chemistry of silica-based organic-inorganic hybrid materials and electro(analytical) chemistry. He has authored and co-authored about 140 papers in international journals and conference proceedings as well as 8 book chapters upon invitation. He is recipient of the Tajima Prize 2006 of the International Society of Electrochemistry.

Plenary Lecture 2

Molecular Beam Epitaxy: From Quantum Wells to Quantum Dots From Research to Mass Production

Professor Mohamed Henini
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Abstract: Research on quantum wells, quantum dots, and superlattices has rapidly expanded during the past decade due to their potential applications in novel devices and their many unique physical properties. Molecular Beam Epitaxy, a sophisticated technology for the growth of high quality epitaxial layers of semiconductor materials, has played an important role in the study of low dimensional structures and devices (LDSD) and the development of the semiconductor electronics industry. The remarkable properties of LDSD make them an attractive candidate to develop semiconductor-based applications for exploitation in novel nanoelectronic and optoelectronic devices.
In this talk I will review the main achievements of Molecular Beam Epitaxy in fundamental research and manufacturing, provide an insight in the growth and properties of self-assembled quantum dots, and report on some new developments in novel material systems.

Brief Biography of the Speaker:
Mohamed Henini obtained his first degree at the University of Oran, Algeria. This was followed by a period of work as a Production Engineer for an electronic company (SONELEC) in Sidi Bel Abbes, Algeria . He came to Nottingham University and was awarded the PhD degree for research in Deep Level Transient Spectroscopy (DLTS) in 1984. He remained in the Electrical and Electronic Engineering Department as a Research Fellow in the area of Transmission Line Modelling (TLM). In September 1986 he transferred to the Physics Department where he is now Professor of Applied Physics. He has over 20 years of experience in Molecular Beam Epitaxy (MBE) growth. His particular speciality is the physics and technology of MBE growth for III-V electronic and optoelectronic devices. Over the years, he has made contributions to various aspects of III-V materials and devices for photonic and high speed electronic applications. He has been acknowledged as responsible for several "world firsts" in MBE growth. During the last few years he has achieved a further significant breakthrough producing new state-of-the-art materials containing quantum dots (QDs). He Ranked 1st (UK) and 14th (internationally) out of Top 25 Authors on QDs for the period 1992-2002 (ISI Essential Science Indicators; http://www.esi-topics.com/). He has authored and co-authored over 750 papers in international journals and conference proceedings. He is the founder of two international conferences namely, Low Dimensional Structures and Devices (LDSD) and Epitaxial Semiconductors on Patterned Substrates and Novel Index Surfaces (ESPS-NIS). He edited four books which were published by Elsevier and serves on the Editorial Board of several scientific journals.

Plenary Lecture 3

Nanomedicine

Professor Anthony P. F. Turner
Cranfield University, Cranfield
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E-mail: a.p.turner@cranfield.ac.uk

Abstract: Healthcare management for the elderly, chronic and acute disease management, critical care, personalised medicine, imaging, toxicogenomics and theranostics continue to challenge our ingenuity as clinicians or technologists and nanotechnology offers promising routes forward to provide new solutions. Increasing demand and awareness of applications of nanotechnology in medicine has resulted in the emergence of a new discipline, namely Nanomedicine, which is now growing at a rapid rate and already solving many challenges faced within various professional bodies, such as healthcare systems, government agencies and industrial companies. The application of science and technology at the nano-scale promises to revolutionise medicine in the 21st Century, enabling us to understand many diseases leading to new insights in diagnostics and therapy and contributing to the development of new generations of medicinal products exploiting:

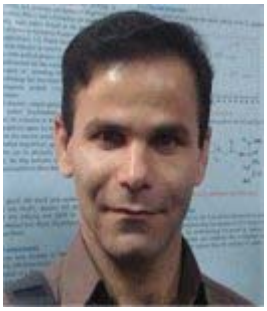
- Functional Materials
- Nanoengineering
- Medical Nano-Devices
- Nanobiology in Medicine
- Nanopharmaceuticals
- Nanotoxicology

In forwarding Nanomedicine as a business venture, however, it will be essential to manage risk communication and perception in this exciting new field. This presentation will briefly review applications of functionalised nanoparticles for imaging, nanostructuring of the surface of implants for improved performance and longevity, scaffolds for regenerative medicine, nano-electro-mechanical systems for improvement of faculties, nanoparticles for pharmaceutical delivery and some of the new ethical challenges that we will face. The market for nanomaterials will be explored and specific example of the use of dendrimers and hyperbranched polymers in electrochemical sensors for diabetes, signalling polymers used as “smart tattoos” and nanoparticulate “plastic antibodies” will be described in detail, the latter providing an attractive alternative to antibodies for sensors, imaging and even therapeutics.

Brief Biography of the Speaker:
Professor Turner's name is synonymous with the field of biosensors. Formerly Principal of Cranfield University at Silsoe, he is now the Distinguished Professor of Biotechnology at Cranfield University, Commercial Director for Cranfield Health and Director, Cranfield Ventures Ltd, with responsibility for leveraging the University's IP in the health and environment sectors. He is a Fellow of the Royal Society of Chemistry, has higher doctorates for his exceptional contribution to biosensors and his contribution to higher education, and is a Foreign Associate of the USA National Academy of Engineering. He led the team that pioneered the technology that now dominates the home blood glucose monitoring market and continues to work for and advise companies and governments worldwide in analytical biotechnology. He has served as an Expert Witness in patent litigations on three continents. Professor Turner has edited the principal journal in the field, Biosensors & Bioelectronics, since its foundation in 1985 and published the first text book on Biosensors in 1987. He has over 600 publications and patents in the field of biosensors and biomimetic sensors and has presented well over 400 keynote and plenary lectures. In association with the UK Institute of Nanotechnology, he has developed and delivered a suite of Short Courses in Nanomedicine and Cranfield University has recently launched the first Masters Course in Nanomedicine.

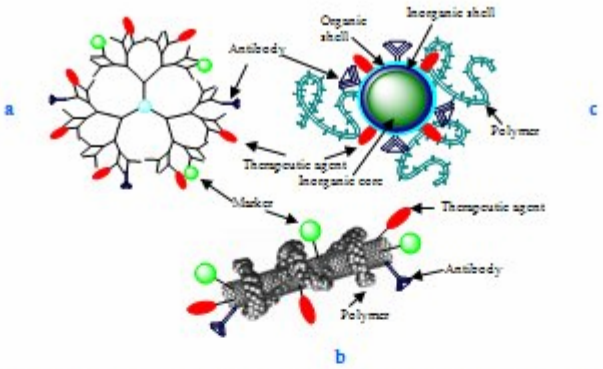
Plenary Lecture 4

Cancer Therapy Based on Hybrid Nanostructures

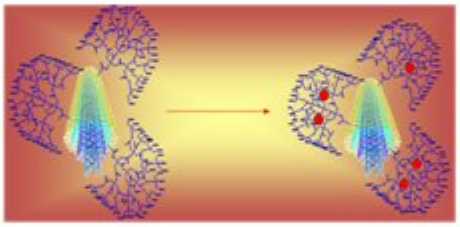


Assistant Professor Mohsen Adeli
Co-author: Fatemeh Zabihi
Department of Organic Chemistry, Faculty of chemistry
Sharif University, Tehran, IRAN
Adeli@sharif.ir

Abstract: Cancer is one of the top three "killers" in the world which include cardiovascular diseases. Unfortunately treatment options for cancer patients are not effective and in the most cases these options lead to destruction the healthy tissues more than tumors. A promising strategy to overcome this problem is development of the effective delivery systems, for therapeutic and diagnostic agents, based on nanomaterials and nanostructures. This strategy is called "nanomedicine".
To be an effective and perfect delivery system, nanostructures should have several characteristics.
i) High functionality to conjugate multiple diagnostic and therapeutic agents on their surface and to have effective interaction with target cells.
ii) Ability to cross different barriers, especially cell and perinuclear membrane, in body
iii) Biocompatibility and water solubility
iv)Inertness against biological active molecules
v) No immunogenicity effect
vi) Stability in biological systems
vii) Release diagnostic and therapeutic agents in destination organelles
vii) Break down to biocompatible materials in destination organelle and …
There are three classes of nanomaterials which promise to be particularly capable agents in the detection, diagnosis, and treatment of cancer (Scheme 1).
i) dendritic polymers (DPs), ii) carbon nanotubes (CNTs) and iii) quantum dots (QDs)
Although delivery systems based on these nanomaterials are valuable and sometimes effective, but they suffer several disadvantages and can not taken into account as perfect delivery systems for drugs or diagnostic agents.
However a very young and promising strategy to overcome disadvantages of above delivery systems and produce perfect targeted delivery systems for drugs or diagnostic agents is to make hybrid systems containing all mentioned nanomaterials. This strategy leads to new nano-scale materials called "hybrid nanostructures".
Hybrid functional nanostructures containing CNTs, DPs and QDs are synthesized and characterized by our group recently (Scheme 2) [1]. Short-term in vitro cytotoxicity and hemocompatibility tests has been conducted on HT1080 cell line (human Fibrosarcoma), in order to investigate their potential application in nanomedicine and to understand the limitation and capability of hybrid materials as nanoexcipients in biological systems. According to the results of the in vitro cytotoxicity tests and hemolysis assay, negligible adverse effects on the HT1080 cell and also red blood cells up to 1 mg/ml concentration were observed. Anticancer drugs and antibodies were attached to the functional groups of hybrid nanomaterials and their potential application to kill different cancer cells in vitro conditions was investigated (Figure 1).



Scheme 1. Drug delivery or diagnostic systems based on a) dendritic polymers, b) carbon nanotubes and c) quantum dots.



Scheme 2. A hybrid nanostructure consisting CNT, DPs and QDs.

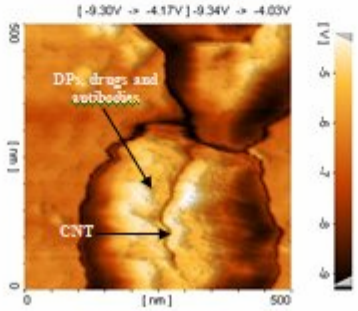


Figure 1. AFM image of a CNT-graft-DPS containing anticancer drug and antibody.

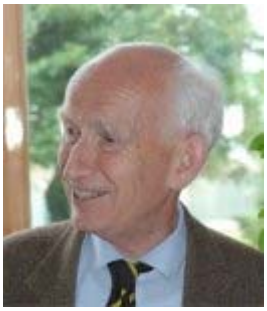
Brief Biography of the Speaker:

Mohsen Adeli is Ph.D in the Hybrid Nanostructures and their applications in nanomedicine at the Sharif University of Technology (Tehran, Iran). After a PhD in 2005 from the Tabriz University and a postdoctoral research in the Institute for Nanoscience and Nanotechnology of Sharif University of Technology he became assiatant proffesor of chemistry at Lorestan University. His research is focused on synthesis and charactrization of hybrid nanostructures containing dendrimers, carbon nanotubes, quantum dots and polyrotaxanes and their applications for cancer therapy.

Mohsen Adeli (born in Khoramabad, Iran in 1974) received his undergraduate degree in Chemistry in 1996 at the Lorestan University. He obtained his MS and PhD degree cumlaude in 1998 and 2005 at the Tabriz University respectively. He performed his Ms research in the field of polymer chemistry which was include synthesis of new types of living polymers containing 2,5-norbornadien and ethyl methacrylate monomers and preparation of di- and tri-block copolymers under the supervision of professor Ali akbar Entezami. He performed his PhD research in the field of organic chemistry with a study on the synthesis and characterization of biocompatible dendrimers and dendritic polymers under the supervision of professor Hassan Namazi. Mohsen Adeli started his carrier at Lorestan University in 2005, where he was active as assistant professor in the field of functional hybrid nanomaterials, including carbon nanotubes and dendritic polymers. Then he introduced to the Institute for Nanoscience and Nanotechnology of Sharif University of Technology for a postdoctoral research in 2007, where he initiated a research work on the hybrid functional nanomaterials, including dendritic polymers and quantum dots. He is assistant professor of Faculty of Chemistry of Sharif University of Technology now.

Plenary Lecture 5

Exact Optics of Fast Wide-Field Telescopes



Professor Donald Lynden-Bell
Institute of Astronomy
University of Cambridge
E-mail: dlb@ast.cam.ac.uk

Abstract: Large telescopes have to be short and therefore optically fast. This makes it difficult to achieve wide fields. The subject's history is briefly reviewed including projects yet to be completed. The best combination of wide (> 4 degree) field and short telescope achieved as yet is Willstrop's three mirror telescope. The analytic theory of all three-mirror aplanatic telescopes is then developed and the problem solved for the special case of a parabolic primary. Exploration of the problem for a primary of any given shape is still in progress.

Brief Biography of the Speaker:
Donald Lynden-Bell is Emeritus Professor of Astrophysics at the University of Cambridge where he held his chair 1972-2001. He was director of the University's Institute of Astronomy 1972-77,1982-87,1992-94. After taking his MA and PhD in Cambridge(1960)he was a postdoc at Caltech and the Mt Wilson and Palomar Observatories where he worked with Eggen and Sandage on Evidence as to how the Galaxy formed. He returned to the Mathematics department DAMTP in Cambridge and to his fellowship at Clare College but then left for 7 years of astronomy at the Royal Greenwich Observatory at Herstmonceux Castle in Sussex. There in 1969 he produced his theory that Quasars were giant black holes in the Nuclei of Galaxies accreting matter. For this work he was awarded in 2008 the first Kavli prize in Astrophysics jointly with Maarten Schmidt who discovered Quasars.
He is a fellow of the Royal Society, A foreign member of the US National Academy of Sciences, a past president and gold medallist of the Royal Astronomical Society, A foreign member of the AAS and a Bruce Medallist of the Astronomical Society of the Pacific. Interests include: Relativity, Dynamics, Statistical Mechanics, MHD. Galaxies. His first paper on optics was in 2002.

Plenary Lecture 6

Combined Spectral and Finite Difference Methods for a Stationary Neutron Transport Equation

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Abstract: The spectral method that we use in our paper is closely related with the finite element method (FEM). The main difference between them is that FEM approximates the solution as a linear combination of piecewise functions, which are nonzero on small sub-domains, while a spectral method approximates the solutions as linear combination of continuous functions that are generally nonzero over the domain of solution. Therefore, the finite element method is a local approach, while the spectral method is a global approach of the phenomenon. The approximate solution of our boundary problem for an integral-differential equation is a trigonometric series with variable coefficients. The comparative study of this solution with the exact solution for a numerical example leads to the conclusions regarding the values of errors.

Brief Biography of the Speaker:
Olga Martin graduated the Faculty of Mathematics and Mechanics, University of Bucharest, Romania. She received his PhD in mathematics with the specialization in Dynamic Plasticity with paperwork 'Applications of the Finite Element Method in Dynamic Plasticity'. During of twenty years, she had been senior researcher in Aircraft Institute, Strength Materials Department. Technical experience: structural strength computing reports using ANSYS program (wing-fuselage, fuselage frame, fin, elevator, rudder and aileron), dynamic and static test-programs for aircraft structures, fatigue test-programs for aircraft structures, iterative methods for the study of the reactions, which correspond to movable control surfaces, attached at n – points to an elastic structure and program of this, static and fatigue computation of the propeller (mono-bloc hub, blades and blades retention system).
Nowadays, she is Professor, Applied Sciences Faculty, University Politehnica of Bucharest.
Fields of specialization: Mathematical Analysis, Mathematical Physics, Computational and Experimental Solid Mechanics, Numerical Analysis, Statistical Calculus.
She has published over 80 research papers and 18 books.
Member of the editorial boards of Politehnica Sci. Bull. Series A, WSEAS Transactions on Applied and Theoretical Mechanics, WSEAS Transactions on Mathematics and she was involved in the program/organizing committees for many international conferences.
Membership of Professional Societies: Society of Computer Aided Engineering – Member National Union of Romanian Scientists (Founding member), Balkan Society of Geometers member.
Reviewer: WSEAS Press (books and journals), Scientific Bulletin, Politehnica University of Bucharest
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