‘Nanomaterials for Biosensors’

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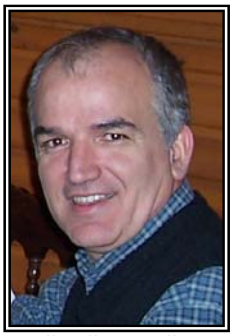
Abstract

The aim of this course is to show some aspects of the implementation of nanomaterials in bioanalysis in general and biosensors particularly. The integration of nanomaterials into biosensing systems represents one of the hottest topics of the today nanotechnology and nanoscience. It is due to the capacity of nanomaterials that an improved stability, minimization of sensor’s surface fouling, an increased sensitivity, multiplexing capacity along with an improved cost-efficiency are being achieved.

The immobilization of nanomaterials onto sensing devices generates novel interfaces that enable the sensitive optical or electrochemical detection of molecular and biomolecular analytes. Moreover nanomaterials are being used as effective labels to amplify the analysis and to design novel biomaterial architectures with pre-designed and controlled functions with interest for several applications. Examples related to nanoparticles, nanotubes, nanowires and nanochannels that explain the mentioned advantages will be discussed.

How does the biosensor community implement the advantages offered by nanomaterials? What are the challenges facing the biosensors while using nanomaterials? How should we move from ‘laboratory use only’ towards real world application of these kinds of biosensors? These will be some of the questions that will be responding during this course in addition to clarifications related to the responses mechanisms associated with nanomaterials integration.

Biography



Arben Merkoçi is ICREA Research Professor and head of the Nanobioelectronics & Biosensors Group at Catalan Institute of Nanotechnology, CIN2 (ICN-CSIC) in Bellaterra (Barcelona), Spain. He studied industrial chemistry at University of Tirana (Albania) and obtained the PhD at the same university working on the field of ion selective electrodes. Afterwards he has been working as postdoctoral fellow and research professor at Polytechnic University of Budapest (Hungary), University of Ioanina (Greece), Università degli Studi di Padua (Italy), Universitat Politècnica de Catalunya (Spain), Universitat Autònoma de Barcelona (Spain) and New Mexico State University (USA). His research is focused on the integration of biological molecules (DNA, antibodies, cells and enzymes) and other species with micro- and nanostructures with interest for the design of novel sensors and biosensors. He is author of more than 300 refereed papers and international presentations including editor of books and special journals issues dedicated to the field of nanomaterials applications in biosensors.

‘Stimulus Responsive Molecules and Switchable Materials’

Dermot Diamond
National Centre for Sensor Research, Dublin City University

Abstract

The presentation will focus on the design and properties of molecular sensors and actuators, and will include discussion of topics such as;

- Can guest recognition be predesigned?
- Molecular sensor transduction choices; examples to include electrochemical (potentiometric) and optical (colorimetric)
- Integration of molecular sensors into sensing platforms and devices
- The emerging area of ‘switchable’ and ‘stimuli-responsive’ materials
- Electrochemical and optically switchable polymer (biomimetic) actuators
- Controlling fluidic systems – polymer pumps, valves, photo-controlled flow
- Remote sensing and autonomous sensors for monitoring the molecular world – realising large scale deployments of chemo/bio-sensor networks

The overall aim of the presentation is to show that control of molecular structure and surface topology at the nanoscale is vital for the realisation of effective next-generation sensors and actuators.

Biography

Dermot Diamond received his Ph.D. and D.Sc. from Queen's University Belfast (Chemical Sensors, 1987, Internet Scale Sensing, 2002), and was VP for Research at Dublin City University (DCU), Ireland (2002-2004).
He has published over 200 peer-reviewed papers in international science journals, is a named inventor in 13 patents, and is co-author and editor of three books.
Professor Diamond is currently director of the ***National Centre for Sensor Research*** at DCU (www.ncsr.ie) and a Principal Investigator in **CLARITY**(www.clarity-centre.com), a major research initiative focused on wireless sensor networks. In 2002 he was awarded the inaugural silver medal for Sensor Research by the Royal Society of Chemistry, London, and in 2006 he received the DCU President’s Award for research excellence. Details of his research can be found at http://www.dcu.ie/chemistry/asg/.

‘Biosensors and Systems Integration’

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Abstract

New concepts for molecular recognition, integration of microfluidics and optics, simplified fabrication technologies, and improved approaches to biosensor system integration are producing smaller, faster, cheaper biosensors with capacity to provide effective and actionable information. We have combined microfluidic mixers, Dean-based separation systems, magnetic field control, and hydrodynamic focusing methods to move target molecules and cells into a variety of interrogation devices. These approaches achieve improved target delivery to sensors and reduced clogging. Most importantly, we have focused on issues critical for effective systems integration, including the interactivity of the choices for sampling technology, biochemistry, optics, fluidics, and electronics. The overall sensing geometry, size, power, and data readout must address the sensing needs and the user requirements—in a final format that is as simple, robust, and inexpensive as possible.

Biography

Frances S. Ligler is the Navy’s Senior Scientist for Biosensors and Biomaterials and Chair of the Bioengineering Section of the National Academy of Engineering. She earned a B.S. from Furman University and both a D.Phil. and a D.Sc. from Oxford University. Currently working in the fields of biosensors and microfluidics, she has also performed research in biochemistry, immunology, and proteomics. She has over 300 full-length publications and patents, which have been cited over 6100 times. She is the winner of the Navy Superior Civilian Service Medal, the National Drug Control Policy Technology Transfer Award, the Chemical Society Hillebrand Award, Navy Merit Award, NRL Technology Transfer Award, three NRL Edison Awards for Patent of the Year, the Furman University Bell Tower and Distinguished Alumni of the 20th Century Awards, and the national Women in Science and Engineering (WISE) Outstanding Achievement in Science Award. She was elected the chair of the 1994 Gordon Research Conference on Bio/Analytical Sensors and an SPIE Fellow, and serves as an Associate Editor of Analytical Chemistry and a regional editor for North and South America for Biosensors & Bioelectronics. She is also on the editorial boards of Applied Biochemistry & Biotechnology, J. Microbiological Methods, Sensors, and Open Optics. She is the American representative on the organizing committee for the International Biosensors Congress (Japan 2002, Spain 2004, Canada 2006, China 2008, United Kingdom 2010) and was elected to the permanent organizing committee of the European Conference on Optical Sensors (UK 2002, Spain 2004, Germany 2006, Ireland 2008, Czech Republic 2010). In 2003, she was awarded the Homeland Security Award (Biological, Radiological, Nuclear Field) by the Christopher Columbus Foundation and the Presidential Rank of Distinguished Senior Professional by President Bush.