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מכון אילזה כ"ץ למדע וטכנולוגיה בתחום הננומטרי
Ilse Katz Institute for Nanoscale Science and Technology

Nanotechnology Special Seminar, Sunday, November 4th, 11:00
IKI Auditorium, Building 51, room 015

Functional Nanomaterials for Bio-Electrochemical Devices

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Abstract:
Bio-electrochemistry research in our group has been focused on building suitable materials and design of interfaces to accommodate biocatalysts, both enzymatic and microbial for most advantageous utilization in sensing, energy harvesting and water treatment technologies. Over the years we have demonstrated several enabling materials design approaches to address critical challenges in bio-electrocatalysis: facilitating charge transfer through tethering immobilization, enzyme orientation, hierarchically structured nano-materials integrated into device design, immobilization by encapsulation in polymer and silica matrixes and development of hybrid microbial/enzymatic and microbial/platinum group metal-free bioelectrochemical devices.

One particularly complex area of our research over the last yeas has been in development of materials solutions for catalytic cascades, which integrate bio-catalysis with molecular and heterogeneous catalytic steps. We are currently engaged in a large program directed towards bringing together functional catalysts from the most distinctly different types: enzymes, molecular catalyst and metallic nanoparticles into a singular functional interface for realization of cascade reactions catalyzed by all these different species/moieties. We will illustrate the approach by discussing the synthesis of a hybrid enzyme/metal nano-particle/atomically-dispersed nano-material functional catalyst cascade.

This lecture aims to bring a vision of building bio-electrochemical devices, where enzymatic catalysis will be enhanced by the heterogeneous and molecular one, with all catalytic moieties co-present at a single "designer interface" based on graphene-like carbonaceous material. This material allows ease of integration by printing into a paper-based microfluidic analytical platform designed for a confocal Raman microscope with in situ spectro-electrochemical detection.

Biography:

Plamen Atanassov graduated from the University of Sofia (1987) specializing in Chemical Physics & Theoretical Chemistry. He joined the Bulgarian Academy of Sciences (BAS) and become a Member of Technical Staff of its Central Laboratory of Electrochemical Power Sources (now the Institute for Electrochemistry & Power Systems). His initial work included materials solutions for metal-air batteries. He was a visiting scientist at the Frumkin's Institute of Electrochemistry, Moscow, Russia studying bio-electrochemistry of enzymes and received a PhD in Physical Chemistry/ Electrochemistry from BAS.

Dr. Atanassov moved to the United States in 1992 and became a research faculty with the University of New Mexico (UNM). During the 90s he was involved in development of a several electrochemical biosensor technologies for biomedical, environmental, food safety and defense applications. In 1999 Plamen Atanassov joined Superior MicroPowders LLC (acquired later by Cabot Corp.), were he was a project leader in fuel cell electrocatalysts development, and introduced spray pyrolysis for catalyst synthesis on industrial scale. He returned to UNM in 2000 as faculty member of the Chemical & Nuclear Engineering department. In 2007 Dr. Atanassov founded the UNM Center for Emerging Energy Technologies (CEET). From January 2012 to December 2013 Dr. Atanassov was the Associate Dean for Research of the UNM School of Engineering. July of 2015 Dr. Atanassov was promoted to a Distinguished Professor of Chemical & Biological Engineering and Chemistry & Chemical Biology. From January 2015 to September 2018 he served as director of the UNM Center for Micro-Engineered Materials (CMEM).

Starting October 2018 Dr. Atanassov joined University of California, Irvine where he is a Chancellor's Professor of Chemical Engineering & Materials Science and had joined the newly formed Department of Chemical & Biomolecular Engineering. He is also affiliated with Los Alamos National Laboratory and is Honorary Professor of The Bulgarian Academy of Sciences. He served as a Vice-President of the International Society of Electrochemistry (2015-207) and is a Fellow of the Electrochemical Society. In 2018 he was inducted in the National Academy of Inventors.

Dr. Atanassov materials for energy programs are focused on development of novel electrocatalysts: non-platinum electrocatalyst for fuel cells, nano-structured catalysts for oxidation of complex fuels, and new materials and technologies for energy conversion and storage. Dr. Atanassov bio-electrocatalysis programs range from enzyme electrochemistry, enzymatic and microbial fuel cells, and systems for biological and bio-inspired energy harvesting. Dr. Atanassov was the lead/principal investigator on DOD-AFOSR MURI and DOE-EPSCoR New Mexico Implementation Award. His research programs have been funded by DOE-EERE and DOD-ARO, NSF and Bill & Melinda Gates Foundation. He holds 55 issued US patents, substantial number of which have been licensed and are at the core of several catalyst products. He has published more than 370 peer-reviewed papers (bringing 20K+ citations and forming an h-index of 70), 20 chapters in books and edited a book on Enzymatic Fuel Cells. Atanassov serves on the editorial board of ACS Applied Energy Materials, ChemElectroChem (Wiley-VCH) and Electrocatalysis (Springer). He has served as an advisor for 33 completed PhD dissertations at UNM and had advised a number of postdoctoral fellows.