J Material Sci Eng 2013, 2:4
http://dx.doi.org/10.4172/2169-0022.S1.012

OMICS Group Conferences
Accelerating Scientific Discovery
2nd International Conference and Exhibition on
Materials Science & Engineering
October 07-09, 2013 Hampton Inn Tropicana, Las Vegas, NV, USA

Development of nanostructured materials for energy conversion and storage

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There is a growing awareness that nanotechnology will have a profound impact on energy generation, storage, and utilization by exploiting the significant differences of energy states and transport in nanostructures and macrostructures. Nanotechnology-based solutions are being developed for a wide range of energy solutions such as solar cells, hydrogen generation and storage, batteries, and fuel cells. Dr. Sun and his group are focusing on synthesis of various low-dimensional nanomaterials to address challenges in fuel cells and Li batteries.

In this talk, Dr. Sun will report their progresses in synthesis and characterization of various nanomaterials including nanotubes, nanowires, nanoparticles, nanofilms and their composites as well as how to use these nanomaterials to solve problems in fuel cells, Li ion batteries and Li-Air batteries. For example, (i) Dr. Sun will present results of controllable synthesis of graphene and nitrogen-doped graphene with their nanocomposites and their applications as anode for Li ion batteries, as cathode for Li-Air batteries and as Pt support for low temperature for fuel cells. (ii) Dr. Sun will report results of atomic layer deposition (ALD) to fabricate various nanomaterials with highly tunable structures and their applications as electrodes for PEM fuel cells and Li ion batteries.

Biography

Andy (Xueliang) Sun is a Professor and Canada Research Chair at University of Western Ontario, Canada. He received his Ph.D. degree at the University of Manchester, UK, in 1999, and worked as a post-doctoral fellow in the University of British Columbia, Canada, and at the National Institut de la Recherche Scientifique (INRS), Quebec, Canada. His research is to synthesize nanomaterials such as nanotubes, nanowires, nanoparticles and thin films as well as exploring their applications for clean energy including fuel cells, Li-ion batteries and Li-Air batteries.

Sun is an author and co-author of over 150 refereed journals, one book and six book chapters. He holds ten US patents. He is actively collaborating with universities, industries and government labs such as Ballard Power Systems, General Motors, Lithium Phostech Inc., and Canadian National Defence. He received various awards such as Early Researcher Award (2006), Canada Research Chair (2007) and University Faculty Scholar Award (2010). He is serving as an editorial board member of Journal of Material Science & Engineering and ISRN Nanomaterials.

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Nanomaterials in DNA biosensors, layer-by-layer films

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The electroactivity of nucleic acids has allowed the development of more sensitive and rapid electrochemical techniques, based on the differences in the electrochemical behavior of DNA-targeted molecules and DNA. Therefore, electrochemical methods appear to be much more elegant for exploring this interaction mainly due to their reliability, speed, simplicity, and ease of monitoring. Designing suitable electrode materials that can provide a foundation for fabricating electrochemical biosensors is highly necessary. One method for noncovalently immobilizing biomolecules on nanomaterials is to entrap them in a polymer such as polyethyleneimine, Nafion, chitosan, or poly(diallydimethlammonium chloride). The coating polymers not only prevent the aggregation of nanomaterials, but also provide abundant positions for functionalization with second biomolecules. Here, we introduced a new method to prepare layer-by-layer films using poly(diallydimethlammonium chloride), PDDA, as a dispersant of MWCNTs. Positively charged PDDA molecules are easily coated on the negatively charged surface of the MWCNTs by electrostatic interaction. The PDDA molecules can combine considerably well with DNA to form DNA films because it is a strong linear cationic polyelectrolyte. MWCNTs not only display unique electron transfer properties that induce the conductivity of PDDA and improve electron transfer characteristics, but also they increase the amount of PDDA deposited on the electrode as well. $\{MWCNTs\text{-}PDDA/DNA\}_n$ layer by layer films could be assembled on a pencil graphite electrode, where DNA stood for natural double-stranded DNA, and the DNA interaction with the presence of other substances was detected by electrochemical methods.

Biography

Aliasghar Ensafi graduated in Chemistry (M.Sc.) from Shiraz University (Iran) in 1988 and received his Ph.D. in 1991 in Analytical Chemistry in the same university. Then, he joined the Department of Chemistry at the Isfahan University of Technology (Iran). He became a full Professor in 2001. His research interest is the development of new electrochemical and chromogenic biosensors based on DNA and Ag/Ab as diagnostic tools.

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