J Nanomed Nanotechnol 2013, 4:6
http://dx.doi.org/10.4172/2157-7439.S1.015

OMICS Group Conferences
Accelerating Scientific Discovery
3rd International Conference on
Nanotek & Expo
December 02-04, 2013 Hampton Inn Tropicana, Las Vegas, NV, USA

Piezoelectric nanorods for imaging of oil reserves

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We describe the potential of using piezoelectric Lead ZirconateTitanate (PZT) nanorods for imaging of oil reserves. The long axis of PZT nanorods can be made to align in the direction of flow in oil fields. If polarized along a specific axis, the seismic excitation of these nanorods would lead to the generation of electromagnetic signal which can be detected at large distances. The intensity, polarization, timing and direction of this signal would reveal information about flow patterns and distribution of oil in the reservoir.

In order to synthesize anisotropic PZT nanoparticles, we have used a hydrothermal method. We were able to synthesize particles of various shapes by tuning the reaction conditions. The reaction conditions were optimized to grow well separated PZT nanorods on surfaces. The next step is to polarize the nanorods and functionalize one end with a polymer which would enable us to keep all polarizations point in one direction during flow induced alignment.

Biography

Waqqar Ahmed has completed his Ph.D. at the age of 28 years from University of Twente (Netherlands) and postdoctoral studies from Leiden University (Netherlands). He is an Assistant Professor at COMSATS Institute of Information Technology, Islamabad. His research interests include synthesis, patterning and applications of anisotropic metal and metal oxide nanoparticles.

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Molecular electronic devices using carbon nanomaterials-based electrodes

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Universal lithographic methodologies for creating single-molecule devices based on single-walled carbon nanotubes (SWNTs) or graphenes as point contacts has been developed. These contacts are formed by electron beam lithography and precise oxygen plasma etching. Through robust amide linkages, functional molecular bridges with amino groups are covalently wired into carboxylic acid-functionalized nanogaps to afford single-molecule devices with desired functionalities.

In this talk, a method to fabricate nanoelectrodes formed form carbon nanomaterials for improving electrode/semiconductor interfaces will be reported. By using these electrodes, we significantly reduced the contact resistance and thus achieved stimuli-responsive organic nanotransistors with high-performance. These studies apparently provide the deeper understanding of the interplay between molecular structure, assembly, and emergent functions at the molecular level and consequently novel insights into designing novel optoelectronic devices. On the other hand, the talk will detail our rational bioassay techniques by using single-molecule devices capable of subsequent biocompatible assembly through the combination of programmed chemical reactivity and directed self-assembly. We bridge a nanogap with a molecule that can react with a biochemical probe molecule. The probe then binds to a complementary molecule to form a noncovalent assembly. We electrically monitor each step of the process at the single event level and in real time. We have tested this approach in biological systems, including DNA hybridization, DNA-protein interaction, and biotin/streptavidin binding. This methodology demonstrates a connection between electrical conduction and biology that offers a glimpse into the future of integrated multifunctional sensors and devices.

Biography

Xuefeng Guo received his Ph.D. in 2004 from the Institute of Chemistry, Chinese Academy of Science, Beijing. From 2004 to 2007, he was a postdoctoral research scientist at the Columbia University Nanocenter. He joined the faculty as a professor under "Peking 100-Talent" Program at Peking University in 2008. In 2012, he won the national science fund for distinguished young scholars of China. He has over 80 scientific papers, including Science, Acc. Chem. Res., Nature Nanotech., PNAS, Angew. Chem. Int. Ed., and JACS. He was awarded several precious prizes, such as the National Top 100 Excellent Ph. D. Thesis Award in China, Beijing Scientific New Star Award, and the Youth Prize in Chemistry of the Chinese Chemical Society.

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