Physics Colloquium

Michigan Technological University

Thursday, February 11, 2010, 4:00 pm

Room 139, Fisher Hall

Glucose Sensors and Bio-fuel Cells Based on Vertically-Aligned Multi-walled Carbon Nanotubes for Integrated Energy Sensing, Generation, and Storage (SGS) Systems

Archana Pandey
Advisor: Yoke Khin Yap

Abstract: Diabetes is one of the fastest growing public health concerns in the world. This has lead to the demand for miniature glucose sensors that may be implantable in the future. Here we report on the use of polymer embedded Vertically-aligned Multi-Walled Carbon Nanotubes (VA-MWCNTs) for the fabrication of glucose sensors. These sensors, as fabricated by functionalize VA-MWCNTs with glucose oxidase (GOx), shown a high sensitivity of $0.15\mu AmM^{-1}cm^{-2}$ at glucose concentration of ~1mM. The response time of these sensors are less than 10s and the detection limit is 3.8μM at 3 signal/noise ratio. We further found that these sensors can continuously detect glucose molecules for 24hr and can be reused for longer than eight months when kept in proper storage conditions. In addition, functionalize VA-MWCNTs were also used as miniature biofuel cells that can convert glucose into energy. Together with our reported microbatteries , these glucose sensors and biofuel cells may be used in the future for an Integrated Energy Sensing,Generation, and Storage (SGS) Systems. Details will be discussed in the presentation.

Theoretical Study of Physisorption of Nucleobases on Boron Nitride Nanotubes: A New Class of Hybrid Nano-Bio Materials

Saikat Mukhopadhyay
Adviser: Ravindra Pandey

We investigate the adsorption of the nucleic acid bases, adenine (A), guanine (G), cytosine (C), thymine (T) and uracil (U) on the outer wall of a high curvature semiconducting single-walled boron nitride nanotube (BNNT) by first-principles density functional theory calculations. The calculated binding energy shows the order: G>A≈C≈T≈U implying that the interaction strength of the high-curvature BNNT with the nucleobases, G being an exception, is nearly the same. A higher binding energy for the G-BNNT conjugate appears to result from a stronger hybridization of the molecular orbitals of G and BNNT, since the charge transfer involved in the physisorption process is insignificant. A smaller energy gap predicted for the G-BNNT conjugate relative to that of the pristine BNNT may be useful in application of this class of biofunctional materials to the design of the next generation sensing devices.

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