MSE SEMINAR

Materials Science and Engineering
Michigan Technological University

Monday, January 22, 2007
10:00 - 11:00 am
Room 610, M&M Building

Development of Hyper-Nano-Molecular Interconnect Technologies for Giga Scale Integration and Nanomechanical Approach to Biomolecular Recognition

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Molecular self-assembly and nano-bio-integration of nanoscale molecular devices and sensors ranging from molecular nanoelectronics assemblies to biologically functional nanostructures. Successful exploitation of self-assembly and bio-integration for these applications ultimately requires development of new constructs that promote molecular organization with appropriate functionality. Successful approaches can employ biomimicry, utilizing biomaterial self-assembly to form one dimensional (1D) ordered, nano-templates potentially suitable for 1D charge transport for molecular devices and sensors for their ultimate detection. Four altogether different but correlated hyper-nano-Integation technologies will be presented: (1) Hyper molecular interconnect based on genetically engineered polypeptides for 1D charge transport. Polypeptides that fold via established rubrics, undergo intermolecular self-assembly, and present an array of functionalities represent attractive and chemically robust candidates. Of particular interest are sheet forming sequences, which can undergo inter-sheet aggregation significantly increasing the size of the autonomously formed assemblies. Recent application in developing molecular sensors and devices will be discussed. (2) Development of a new electronic transduction paradigm comprising two-dimensional micro cantilever arrays with geometrically configured metal-oxide-semiconductor-field-effect-transistors (MOSFETs) embedded in the high stress region of the microcantilevers. MOSFET-embedded microcantilevers, which realize integration of bio-nanostructures with microelectronics, are able to detect diverse probe-target binding events, ranging from DNA hybridization to protein-protein binding, at high sensitivity and reproducibility will be presented. (3) Novel Scanning ultrasound holography for high resolution buried defects and pattern recognition. This technique fills the critical void in characterization and investigation of the static and dynamic mechanics of nanoscale systems and address emerging issues in imaging and analysis of diverse embeddednano and microscale structures, and engineered systems. The novel application of SNFUH is demonstrated with examples of high resolution pattern recognition of e-beam patterned structures which are buried under Mo/Si multilayer film stack, buried pattern recognition of passivated Cu interconnects under dielectric layers and electro migration, in-vitro imaging of air-bubbles in acoustically active liposome and nanoparticles embedded in cancer cells and (4) Nano-drug delivery using magnetic nanoparticles and gene therapy.

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