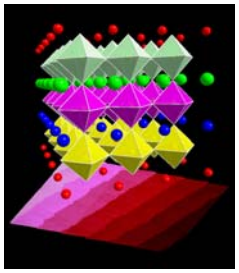
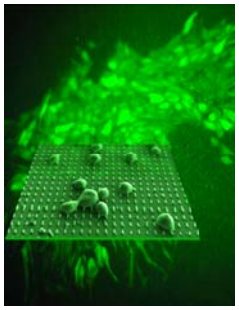
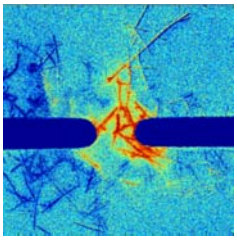
CNMS DISCOVERY SEMINAR SERIES

Friday, August 14, 2009
11:00 am
Iran Thomas Auditorium, 8600







"Designing, Measuring and Controlling Molecular- and Supramolecular-Scale Properties for Molecular Devices"

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Abstract:

We use molecular design, tailored syntheses, intermolecular interactions and selective chemistry to direct molecules into desired positions to create nanostructures, to connect functional molecules to the outside world, and to serve as test structures for measurements of single or bundled molecules. Interactions within and between molecules can be designed, directed, measured, understood and exploited at unprecedented scales. We look at how these interactions influence the chemistry, dynamics, structure, electronic function and other properties. Such interactions can be used to advantage to form precise molecular assemblies, nanostructures, and patterns, and to control and to stabilize function. These nanostructures can be taken all the way down to atomic-scale precision or can be used at larger scales. We select and tailor molecules to choose the intermolecular interaction strengths and the structures formed within the film. We selectively test hypothesized mechanisms for electronic switching and actuated motion by varying molecular design, chemical environment, and measurement conditions to enable or to disable functions and control of these molecules with predictive and testable means. Critical to understanding these variations has been developing the means to make tens to hundreds of thousands of independent single-molecule measurements in order to develop sufficiently significant statistical distributions, comparable to those found in ensemble-averaging measurements, while retaining the heterogeneity of the measurements. We quantitatively compare the conductances of molecule-substrate junctions. We demonstrate the importance of these junctions in conductance switching of single molecules. We find that the contacts and substrate play critical roles in the switching. Switching of rigid, conjugated molecules is due to changes the molecule-substrate bonds, which involves motion of the molecules and also motion of substrate atoms. We are able to measure the coupling of the electrons of the molecules to those of the substrate by measuring the polarizabilities of the connected functional molecules in high and low conductance states. These polarizabilities are compared to those of other families of molecules and to detailed calculations.

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