CIMIT MEETING SUMMARY 07/22/03

Krystyn J. Van Vliet, PhD, Boston Children's Hospital spoke on "Nanomechanics Of Living Cells: Using Nanoscale Contact To Define And Alter Cell State". Studying the nanomechanics of materials has lead to the development of new tools to measure material properties and predict failure with nanoscale resolution. Typically, nanoindention is used to obtain measurements of displacement versus force and the data are used to model material properties and failure. These techniques are now being used to quantify the mechanics of cells and cell components. By imposing nanoscale forces and displacements on the surfaces of living cells, one can study how individual cells sense and respond to both mechanical and chemical stimuli, in vitro and in situ. An understanding of how cells sense and respond to mechanical stimuli may clarify mechanisms of inflammation, wound healing as well as normal development. Applying these techniques to study how disease affects the mechanical state of cells may be useful in targeting therapies and in drug development. The approaches used for such measurements depend on the scale of the object of interest. Cell populations, with 1-mm scale, can be studied by stressing the substrate; single cells can be studied by attaching microbeads which can in turn be moved by laser traps and by optical tweezers. As on a larger scale, the basic measurement is of displacement versus force. Atomic force microscopy (AFM) uses a microscale cantilever with a sharpened point to scan the topography of surface. The deflection of the cantilever beam is obtained by measuring the displacement of a laser beam reflected from its surface. The AFM approach can be modified to obtain displacement versus force curves on a point by point basis, allowing images of the mechanical properties of the surface to be obtained. By coating the AFM probe tip, the interaction can be dominated by ligand-receptor forces, allowing one to image the structure and distribution of proteins on the cell surface, and also quantify the interactions between transmembrane receptors and their ligands. Furthermore, these features can be monitored in real time under time-varying stimuli, and correlated from the genetic to the structural/functional levels.

Jeffery A. Schloss, PhD, NIH spoke on: "Nanoscience and Nanotechnology Research Programs at NIH". The National Institutes of Health support nanoscience and nanotechnology research to advance our understanding of biology and underlying causes of diseases and syndromes and to develop improved methods for diagnosis and treatment of disease. Most of this support is not directly for nanotechnology projects but for nanotechnology as part of a larger project within a variety of programs developed by the NIH Institutes and Centers. The central locus for planning and coordination of nanoscale research is the Bioengineering Consortium (BECON) (www.becon.nih.gov), which also coordinates support for many other bioengineering research projects. Research areas supported by NIH which may involve nanotechnology include sensors, tissue engineering, new contrast agents and single molecule detection. NIH participates in the National Nanotechnology Initiative (NNI), coordinating efforts to stimulate this emerging field with other Federal agencies; the FY 02 funding for the NNI is $697M, most of which is dispersed by NSF, DoD and DOE. Examples of NIH-supported nanotechnology research include quantum-dot targeted fluorescent markers and the development of silicon nanostructures for DNA analysis.