

Nano/Bio Interface Center
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As electronics and machines are driven ever smaller, integration with life systems is inevitable and will have dramatic technological, biomedical, and social implications. Some of the most challenging issues in the 'Nanotechnology Era' are associated with interfacing physical and biological systems. These interfaces have relevance in many dimensions: from the sociology of the human/machine interface to molecular interactions at physical interfaces. The fundamental principles of molecular function at interfaces will dictate how it can be exploited both in an engineering sense and in understanding basic biological processes.

The *Nano/Bio Interface Center (NBIC)* at the University of Pennsylvania exploits Penn's strengths in design of molecular function and quantification of individual molecules. The Center unites investigators from ten departments in three schools (School of Engineering and Applied Science, School of Medicine, and School of Arts and Sciences) to provide, not only new directions for the life sciences, but also for engineering, in a two-way flow essential to fully realizing the benefits of the intersection of biology with nanotechnology.

The research program is structured around two major themes (Biomolecular Function and Molecular Motion) and two cross cutting initiatives (Single Molecule Probes and Ethics). The *NBIC* will house an experimental facility that will be a technical incubator of new probes of single molecule behavior (The Nano Property Lab). This lab will host an international network on single molecule probes that will develop an electronic and a physical platform for global interactions. The *NBIC* partners with the Department of Energy's Center for Integrated Nanotechnologies to develop a Discovery Platform for nanostructural probes, a concept to facilitate rapid and comprehensive determination of nanostructural behavior.

The *Nano/Bio Interface Center* has taken a global view of education, linking the university based educational initiatives with outreach activities to impact future scientists and engineers at all stages of development. With the City of Philadelphia School District we have developed a program that engages high school students in NSEC related science activities, *virtually all of whom will be from underrepresented groups and more than half of whom will be female*. A multi component professional development program will produce modules on NSEC related topics that will be used in the classroom. Penn has established an undergraduate minor in Nanotechnology and a graduate certification in Nanoscale Science and Technology and has partnered with Drexel to establish a unique model of graduate education based on a Two University/One Campus concept.

The research carried out in the *Nano/Bio Interface Center* is organized into three structural categories. Research Teams bring investigators from three schools to comprehensively address an area of molecular functionality from the fundamental origin of the function to potential practical exploitation. Each Research Team is led by two senior investigators, representing two

of the participating schools. Two Cross Cutting Initiatives develop themes that are integral to all of the Research Teams. Shorter term projects seed innovation.

In Research Team -1 biomolecular optoelectronic function is produced by combining a new class of chromophores with synthetic polypeptides. Two new fabrication processes: ferroelectric nanolithography and dielectric electrophoresis, are being used to examine effects of interfaces with these biomolecules. In Research Team -2 the mechanical molecular motion of individual ribosomes and motor proteins is systematically studied in order to determine mechanisms of transduction and translocation, processes that are critical to both cellular function and to engineering molecular motors. Cross Cutting Initiative-1 unites investigators who are developing new approaches to probe and manipulate molecular/nanostructural function to exploit cross fertilization and address challenges particular to molecular function at interfaces. They are specifically forwarding near field optical and fluorescent probes and multiple modulation scanning probes. Cross Cutting Initiative -2 is undertaking a substantive treatment of ethics in nanotechnology as it pertains to the research areas in the *NBIC* and in a broader context. It will apply methods that have been successful in the area of genetically modified food and genomics.

References

[1] For further information about this project link to <www.nanotech.upenn.edu> or email <[<email address\(es\)>](mailto:email address(es))>