Genomics and Systems Biotechnology Laboratory

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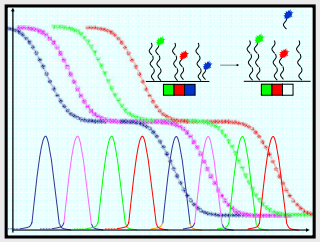
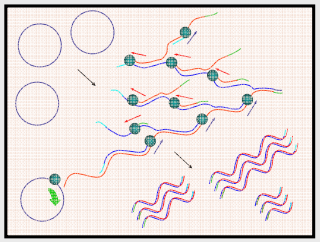
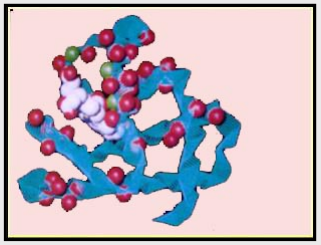
DNA Amplification & Sequencing Technologies

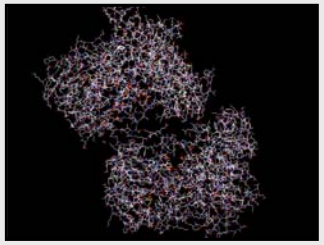




We are currently developing several different approaches to DNA sequencing. Examples include sequencing by denaturation (SBD), sequencing by ligation (SBL), and sequencing by synthesis (SBS). We are also developing new approaches for fragmenting, modifying, and amplifying genomic DNA.

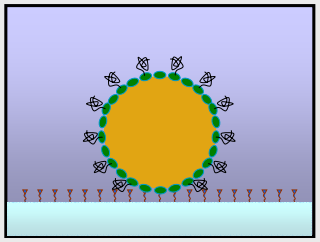
Protein Engineering





We are engineering proteins with new and improved functions and activities using rational design and directed evolution. These modified proteins can be used to catalyze specialized DNA sequencing and amplification reactions that are inefficient or impossible using natural proteins.

Surface, Polymer & Single Molecule Chemistry

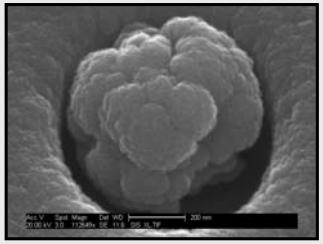


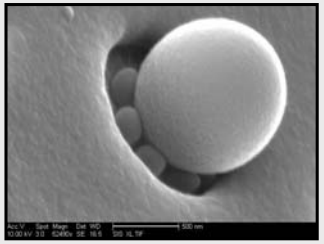
We are exploring numerous approaches to derivatize, modify, conjugate, enhance, and/or passivate surfaces, biomolecules, microbeads, and nanoparticles. Attaching molecules of interest to specialized nanoparticles allow us to image molecular interactions using conventional microscopy.

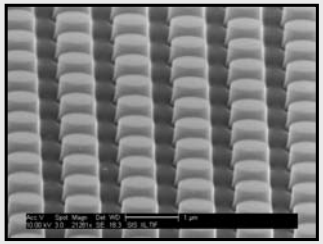
Overview

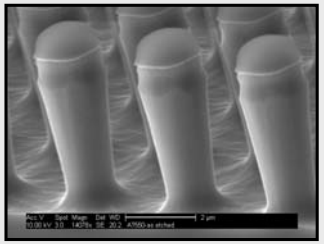
Despite the availability of the human genome sequence and the ever-accelerating pace of biomedical research, the root causes of common human diseases remain largely unknown. The ability to sequence the genomes of a large number of affected individuals and controls would allow us to examine all the genetic differences to search for the molecular etiology of a variety of diseases. Identifying the causal genes and variants would represent a significant step towards improved diagnosis, prevention and treatment of disease. Recently, NIH has initiated an international effort to develop a revolutionary technology that will enable the rapid sequencing of a human genome for as little as $1000. As part of this international effort, we are developing a new paradigm to achieve unprecedented multiplexing, parallelization and miniaturization so that hundreds of millions of DNA samples can be manipulated in a single integrated device.

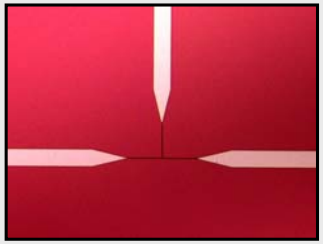
Micro/Nano Fabrication

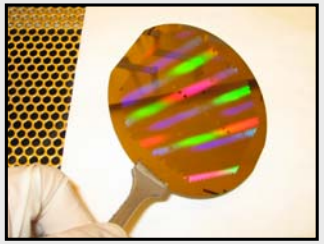






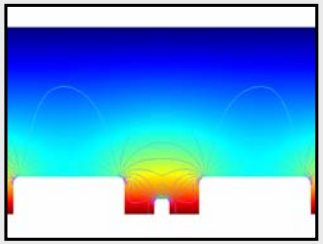


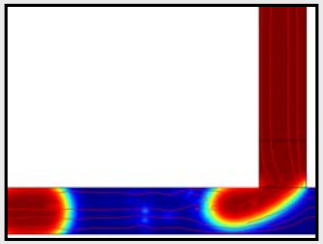




We are utilizing various micro- and nanofabrication techniques to minimize the size and cost and maximize the speed and throughput of our assays. For example, the miniaturization and parallelization of our sequencing methods will allow the genomes of several individuals to be sequenced simultaneously on a single microscope slide.

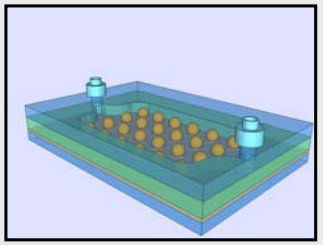
Computational Modeling

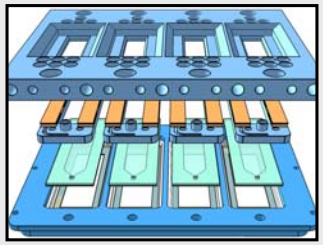




We are interested in modeling the various physical and biochemical phenomena that we often observe in the laboratory setting. These include biochemical reactions, microfluidics, electric and magnetic fields, heat transfer, diffusion, and molecular interactions.

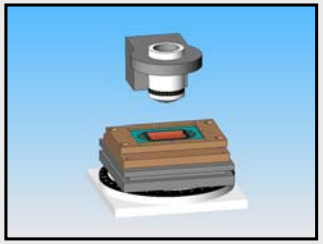
Microfluidics for High-Throughput Assays





We are developing various technologies for rapid, inexpensive, and high-throughput biomolecular analyses. This includes designing and fabricating various microfluidic flow cells and devices to support our high-throughput genomic and proteomic platforms.

Integrated & Automated Systems



We are designing and assembling high-speed automated imaging and fluidics systems using state-of-the-art technology. Critical components include epifluorescence microscopes, EMCCD cameras, lasers, ultra high speed wavelength switchers, motorized stages, pumps, valves and temperature controllers.