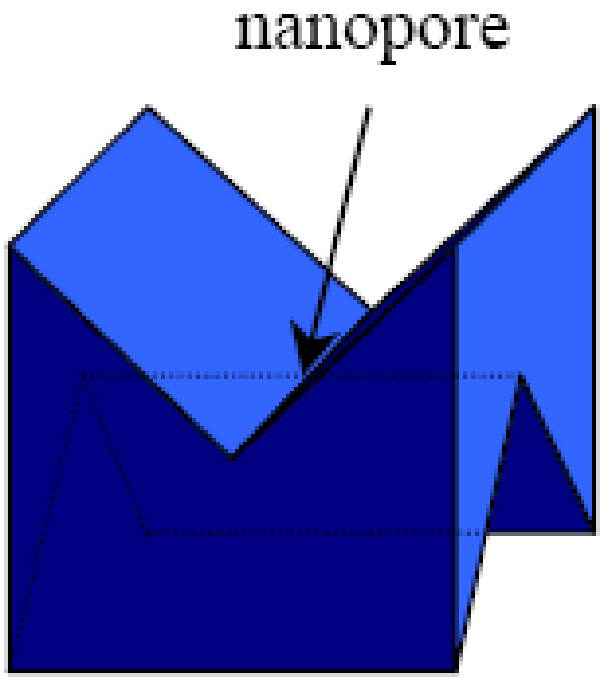
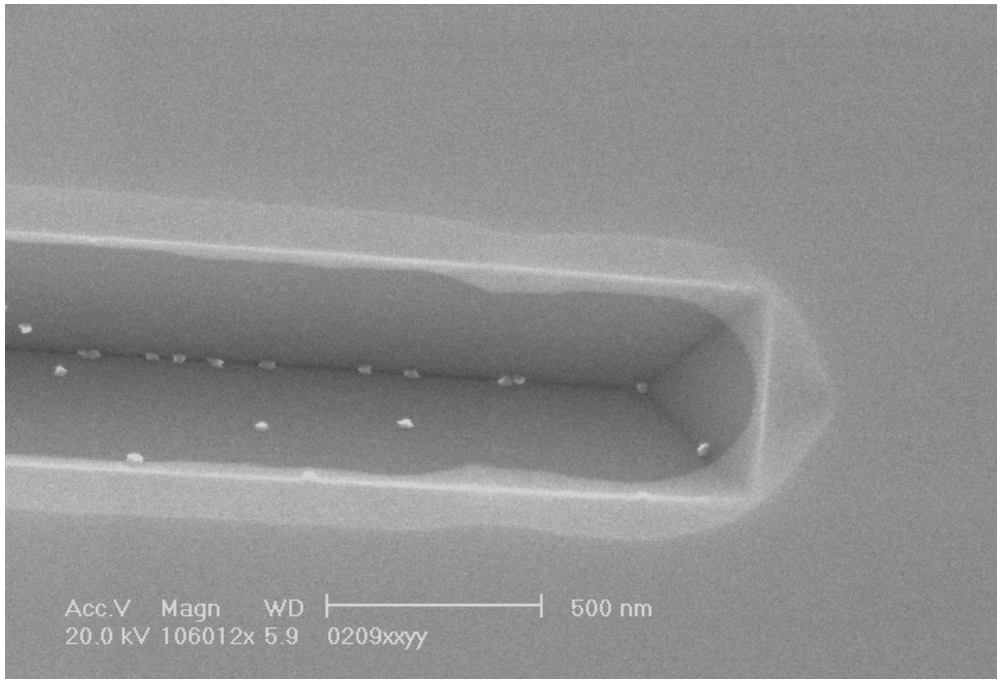
Nanoscale Exploratory Research: DNA Sequence Detection using Novel Solid-State and Soft Nanopores" DMR-0304325: 09/1/03-08/31/04

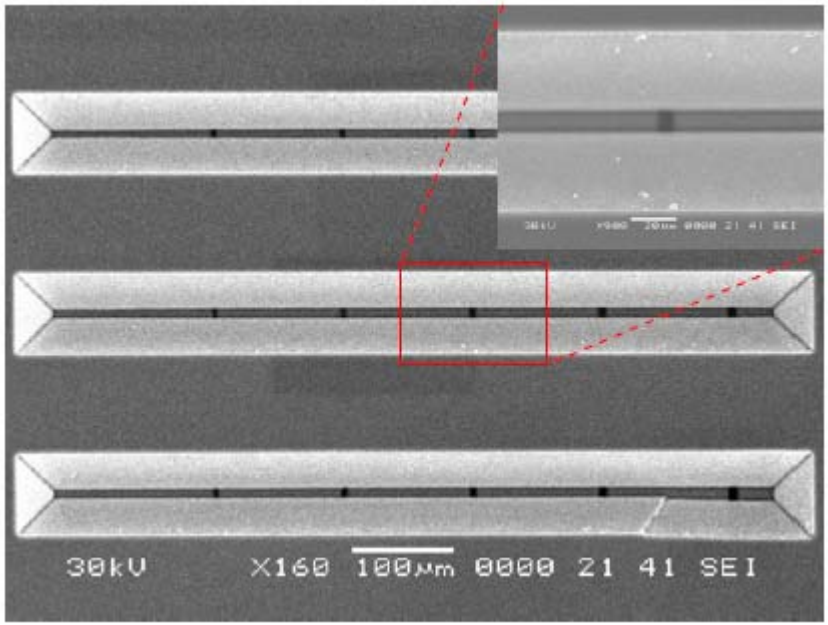
Sean Ling (Brown University)

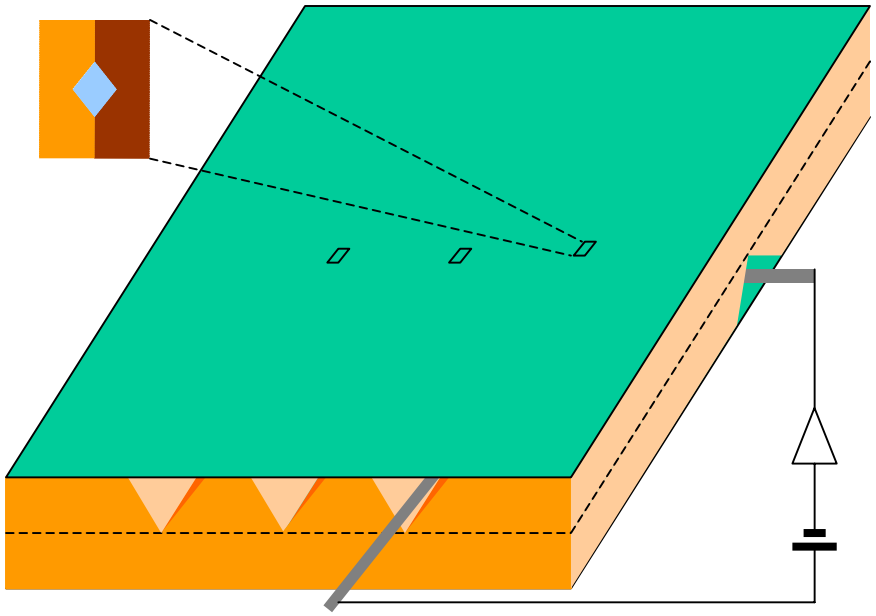
Recent studies of DNA translocation through biological nanopores embedded in an insulating membrane have demonstrated the great potential of nanopores in a wide range of applications in nano-biotechnology, including ultra-fast DNA sequencing, biomolecule sensing, etc. For many of these applications, it is highly desirable to develop solid-state nanopore devices. This one-year Nanoscale Exploratory Research program is to study the feasibility of using a "cutting-edges" concept for making nanopores using both curable polymers (see below left), and silicon technology (see below right).





Imagine a device of the size of a cell phone that can tell you what kind of biological agents are present in a sample, be it a suspicious drop of blood, or a contaminated water source. A molecular biologist can use it for a quick determination of the genetic sequence of a DNA, a soldier in a battlefield can quickly determine if s/he is exposed to a biological attack, or a teenager can determine if s/he is exposed to STDs. Solid-state nanopores have the potential of being the core technology for such a device. Our research program is to bring this dream closer to reality. This one-year NER program has allowed us to establish a strong foothold in this rapidly expanding field of nano-biotechnology.





Students Supported:
This one-year grant provided stipends for two graduate students S.R. Park and I. Dimitrov in the academic year 2003-2004. We carried out a feasibility study of using low-cost SEM-based electron beam lithography and KOH etching to produce parallel V-grooves on both sides of a silicon wafer (see above left). When two V-grooves cross, a pore is created. We are in the process of learning how to control the pore size during etching.

Current Status: We are in the process of developing a fully integrated silicon nanopore array biosystem (see above right) using a patented concept [1] of addressable nanopores for DNA sequencing and other projects in molecular biophysics.

[1] X.S. Ling, patent pending.