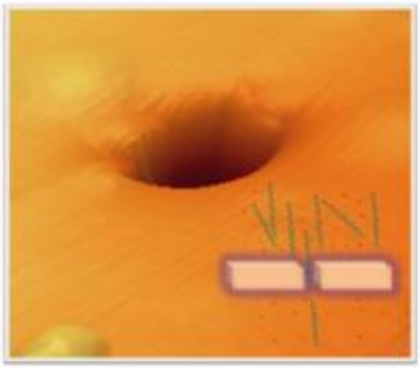
Artificial nanopore production could lead to early detection of disease

April 23 2012, By Herb Booth



An Atomic Force Microscope image of a 100 nm nanopore in silicon. Green is the molecule of interest in sample that will be run through the nanopore in the lab.

(Phys.org) -- A University of Texas at Arlington multi-disciplinary team has received a $360,000 grant from the National Science Foundation to build artificial nanopores made of silicon that can detect “bad molecules” as a very early indication of cancer and other diseases.

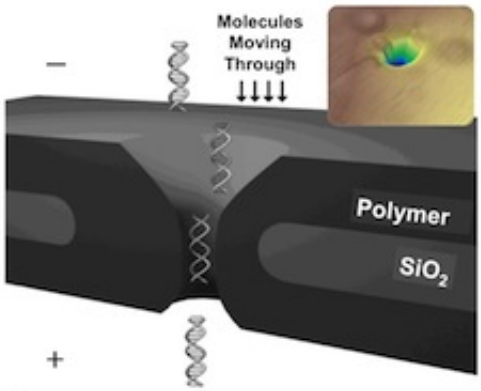
Samir Iqbal, an assistant professor of Electrical Engineering who focuses on nanotechnology, is leading the project. He is working with Purnendu “Sandy” Dasgupta, the Jenkins Garrett Professor of Chemistry and Biochemistry, and Richard Timmons, a Distinguished Professor of Chemistry.

Nanopores are tiny openings about 1,000 times smaller than a human pore on the skin or a human hair, made in very thin silicon chips. The silicon chips are the same material in computer processors and memories.

Iqbal's team will run human blood-derived samples through these artificially created nanopores in a silicon chip and record how the composition may change as a function of disease.

Researchers will measure the reaction between ions of blood and nanopores and compare the data with other non-reactive nanopores, which will determine abnormal levels of particular chemicals that indicate whether a disease is present at the molecular level.

"We know many variants of certain chemicals like enantiomers, or the abnormal amounts of certain chemicals like cholesterol. These chemicals tell us if someone is subject to certain diseases," Iqbal said. "Now we will be able to detect these variants at extremely small amounts and in a portable system format. We'll be able to detect even a few hundred copies of bad molecules to identify risks of diseases like cancer. That is very, very early detection."



An Atomic Force Microscope image of a 100 nm nanopore on right. The sketch

shows molecules in a sample passing through an engineered nanopore.

Enantiomers are mirror-imaged optical isomers or compounds with the same molecular formula but different structural shapes such as a pair of human hands. They are mirror images of each other but not superimposable.

Another example is thalidomide, a drug introduced in the late 1950s to treat morning sickness in pregnant women. One enantiomer of the drug was found to be a good sedative for morning sickness. The mirror image of that enantiomer, present in the drug formulation, however, caused birth defects, leading to the drug being pulled from the market.

Through the new research, Iqbal and his colleagues would be able to determine similar differences at the molecular level, before the bad variants of new molecules cause devastating effects.

With the assistance from the nanopores, researchers will be able to identify what cancer looks like at the molecular level. That's where the expertise of the two UT Arlington chemists lie, Iqbal said.

Timmons has expertise in inserting chemicals in the nanopores. Dasgupta's expertise is in detecting chemicals in trace amounts.

"It's thrilling that we can have a small broadly applicable platform that will be usable in a variety of areas," Dasgupta said.

Team members said crossover applications for the technology also exist. For instance, the nanopore technology detection could be applied to gauge air or water quality.

“Again, the earlier we know whether a water or air source is polluted, the better off the people who live there will be,” Iqbal said.

Carolyn Cason, UT Arlington’s interim vice president for research, said such collaborative research advances the University’s mission.

“It tells everyone here that we can use resources available to us to solve real-world health problems,” Cason said. “This research has health-related consequences that can be felt across the industry.”

Provided by University of Texas at Arlington