Artificial nanopore production could lead to early detection of disease

(Nanowerk News) 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.

"Now we will be able to detect these variants at extremely small amounts and in a porosity that is not currently available," said Iqbal.

Researchers will measure the reaction between ions of blood and nanopores and compare the data with 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 "bad molecules" as a very early indication of cancer and other diseases.

"We know many variants of certain chemicals like enantiomers, or the abnormal amounts that indicate sickness in the system," Iqbal explained.

"bad molecules" are an indicator of disease. This team's goal is to detect them at an early stage before the disease has developed. By detecting these "bad molecules" early, medical treatment can be initiated sooner, potentially saving lives.

"We are focusing on detecting these "bad molecules" at the molecular level, before the bad variants of new molecules cause devastating effects," Iqbal continued.

Researchers will use nanotechnology to develop artificial nanopores that can detect these "bad molecules." These nanopores are tiny openings about 1,000 times smaller than a human pore on the skin or a human hair, which is ideal for detecting small amounts of compounds.

"We are using the molecular level to detect these "bad molecules," Iqbal said. "This technology can help us detect even a few hundred copies of bad molecules to identify when a disease is present at the molecular level."

Researchers will measure the reaction between ions of blood and nanopores and compare the data with 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 silicon chips and record how the composition may change as a function of disease.

Researchers will measure the reaction between ions of blood and nanoparticles 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 that indicate sickness. These chemicals tell us if someone is subject to certain risks of diseases or death," 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."

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, while the other enantiomer led to 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.

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.

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.

"bad molecules" are a key to detecting diseases like cancer. That is very, very early detection.

Researchers direct the self-assembly of gold nanoparticles into device-ready thin films.

"bad molecules" are an indicator of disease. This team's goal is to detect them at an early stage before the disease has developed. By detecting these "bad molecules" early, medical treatment can be initiated sooner, potentially saving lives.

"We are focusing on detecting these "bad molecules" at the molecular level, before the bad variants of new molecules cause devastating effects," Iqbal said.
textbook collects fundamental concepts and key technologies
Posted: Apr 27th, 2012
Donostia welcomes a European Symposium on the Regulatory Framework of Nanotechnologies
Posted: Apr 27th, 2012
Slicing mitotic spindle with lasers, nanosurgeons unravel old pole-to-pole theory
Posted: Apr 26th, 2012
New guide for research on multiblock polymers emerges
Posted: Apr 26th, 2012
Cells in blood vessel found to clinge more tightly in regions of rapid flow
Posted: Apr 26th, 2012
Boron-nitride nanotubes show potential in cancer treatment
Posted: Apr 26th, 2012
Mini cargo transporters on a rat run
Posted: Apr 26th, 2012
Madrid will host the 13th Trends in Nanotechnology International Conference (TNT 2012)
Posted: Apr 26th, 2012
‘Nano Graveyard’ and other amazing nanotechnology images
Posted: Apr 26th, 2012
Chalmers receives $3.3m to upgrade its nanofabrication lab
Posted: Apr 26th, 2012
Licht in Nanostrukturen gefangen
Posted: Apr 26th, 2012
Researcher awarded with “Green Photonics” award for organic solar cells
Posted: Apr 26th, 2012
Tiny crystal revolutionizes computing (w/video)
Posted: Apr 26th, 2012
New nanometer-based magnetoelectric sensors for deep brain stimulation
Posted: Apr 26th, 2012
University of Manchester announces graphene funding call
Posted: Apr 26th, 2012
Boost for commercialization of nanotechnology research as key business figures join board of CRANN
Posted: Apr 26th, 2012

An Atomic Force Microscope image of a 100 nm nanopore on right. The sketch shows molecules in a sample passing through an engineered nanopore.

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."

Source: University of Texas at Arlington

Subscribe to a free copy of our daily Nanowerk Nanotechnology News Email Digest with a compilation of all of the day's news.