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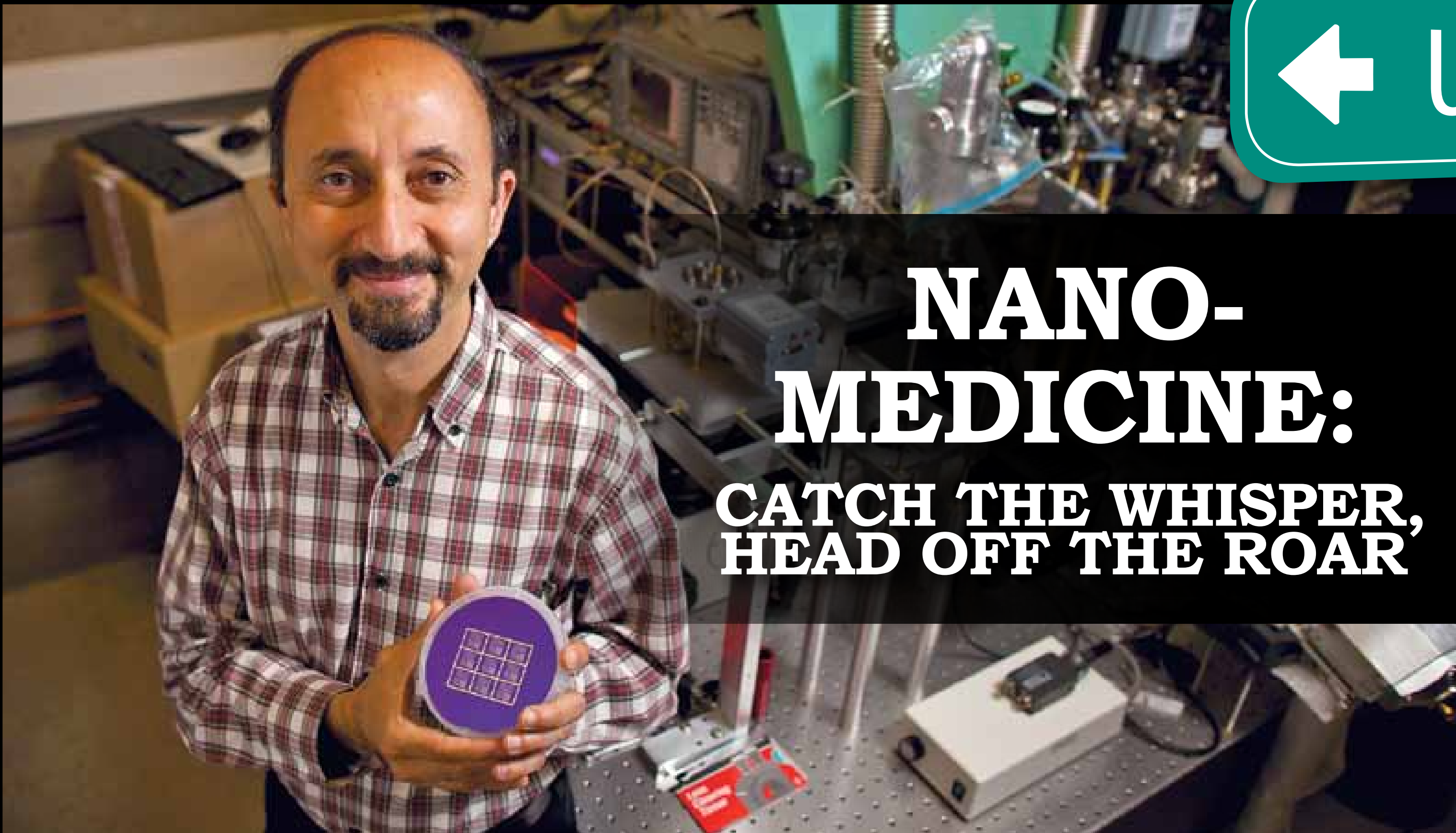

NANO-MEDICINE:

CATCH THE WHISPER, HEAD OFF THE ROAR

Bhiladvala. PHOTO: NIK WEST

While you are going about your day, a few of the trillions of molecules running around inside you could be ducking into shady corners to plot the takeover of your body systems.

A little molecular eavesdropping is forgivable to head off the plot before it gets out of hand. But how? That question hooked University of Victoria engineering professor Dr. Rustom Bhiladvala, who recently published an article about sneaking up on a small number of prostate cancer biomarker molecules in the international journal *Nanomedicine*.

Integrating research from a number of disciplines, Bhiladvala's work in the UVic Nanoscale Transport, Mechanics and Materials Laboratory is done in collaboration with cancer pathologists, chemists and electrical engineers to create nanoscopic (the generation beyond microscopic) sensors.

"These sensors are like an arm," the mechanical engineering professor says, holding his own arm out to illustrate a nanowire. "It's vibrating very fast and is made to respond only to the binding of a very specific disease target molecule." The molecule is named PCA3, and provides a more specific indication of prostate cancer than the commonly used Prostate Specific Antigen (PSA) test.

For the aggressive form of prostate cancer, early detection is crucial, but PSA tests also produce many false positives. One-in-seven Canadian men—a proportion expected to rise to one-in-four within a decade—will receive a warning diagnosis from a PSA test. Yet up to three-quarters of patients who get biopsies after a test end up not having cancer, US National Cancer Institute statistics show.

More accurate test results from a blood sample would provide a better screening procedure for early detection of the disease, and could also save money in health-care costs and recovery time from invasive procedures.

The sensors Bhiladvala's team are working with might be the solution. They are extraordinarily sensitive, meaning they can respond to the very small concentrations of disease markers found in the early stage of cancer—making them highly effective screening tools.

"The nanosensors can detect small numbers of molecules, snagging only those molecules that are produced by cells with particular kinds of cancer. Once those specific molecules are found, then we know that the patient is starting to develop early stages of the disease and should take the appropriate precautions."

Bhiladvala explains that the sensitivity of the nanosensors is what makes them remarkable. "We detect specific marker molecules less than a millionth of the mass of a cell, and there are typically 60,000 of these per prostate cancer cell, so using these sensors, we can jump in and ring the alarm bell at an early stage of the disease."

The technique is described in a recent paper by Bhiladvala and Penn State collaborators, published and marked as having potential clinical relevance in *Nanomedicine*.

Bhiladvala cautions that although the process is simple, there are numerous intricate details when working with nanotechnology, and they will have to be resolved before this new screening process can be put into practice.

To assess the specificity of the nanowire sensor, materials with different related molecules are tested using fluorescence, to see which ones will grab the disease marker molecule, and how successfully. "We have demonstrated sensitive detection with low false-positives for early detection of prostate cancer," says Bhiladvala. "There is still work to be done before this test appears in the doctor's office, but the hope is for a more accurate test for prostate cancer that will get to the market within a decade."

Bhiladvala and his collaborators also hope to extend the application of the technology to multiple biomarkers for the same disease and to other types of cancer, neurodegenerative disorders and genetic diseases.

GREAT MOMENTS IN RESEARCH

UNIVERSITY OF VICTORIA Celebrates 50 YEARS

From TRIUMF to the Large Hadron Collider

When the news broke in summer 2012 that the elusive Higgs boson—the particle believed to be responsible for the mass of all things—had at last been detected, many UVic physicists were in the thick of the global celebration. The achievement caps decades of close collaboration with the TRI-University Meson Facility (TRIUMF), Canada's national laboratory for nuclear and particle physics, which UVic co-founded in 1969 in Vancouver. TRIUMF attracts top physicists from around the world to work on research in particle and nuclear physics, and nuclear medicine. Over the years, TRIUMF has been vital to UVic's leadership on a number of international particle physics projects, including ATLAS, one of two large detectors that record proton collisions at the massive Large Hadron Collider, where hints of the Higgs boson were found. UVic physicists brought Canada into the ATLAS project in 1992 and are responsible for several key components of the detector. Soon a new era of discovery will begin at TRIUMF, with completion of the UVic-led ARIEL accelerator, which will expand Canada's ability to produce and study isotopes for physics and medicine.

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