New blood scanner detects even faint indicators of cancer

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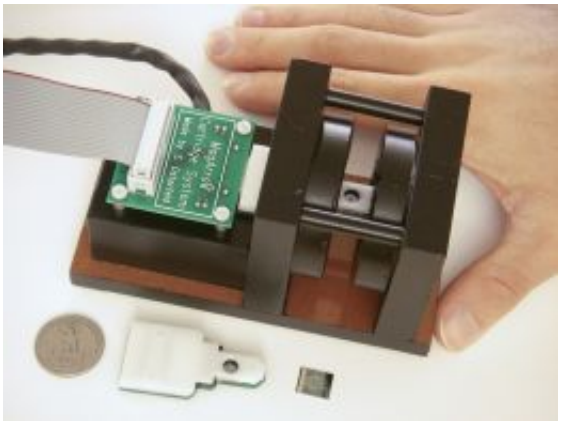

(PhysOrg.com) -- A team led by Stanford researchers has developed a prototype blood scanner that can find cancer markers in the bloodstream in early stages of the disease, potentially allowing for earlier treatment and dramatically improved chances of survival.

The system based on MagArray biodetection chips can find cancer-associated proteins in a blood serum sample in less than an hour, and with much greater sensitivity than existing commercial devices. In fact, the device, which uses magnetic nanotechnology to spot the cancer proteins, is tens to hundreds of times more sensitive, meaning the proteins can be found while there are relatively few of them in the bloodstream. The researchers reported their results in the Dec. 1 online

edition of the *Proceedings of the National Academy of Sciences* (*PNAS*).

"This is essentially a proof-of-concept study showing that now we have a chip and a reader that can find multiple biomarkers in a sample at a concentration much lower than the standard that is commercially available," said Shan Wang, a Stanford professor of materials science and of electrical engineering.

Wang is optimistic that the technology will someday save lives by detecting cancer early or by helping doctors select more effective therapy. "The earlier you can detect a cancer, the better chance you have to kill it," he said. "This could be especially helpful for lung cancer, ovarian cancer and pancreatic cancer, because those cancers are hidden in the body."

Wang is a senior author of the paper, along with Stanford biochemistry and genetics Professor Ronald W. Davis of the Stanford Genome Technology Center, and UC Santa Cruz biomolecular engineering Professor Nader Pourmand.

The detector is able to detect many different kinds of proteins at the same time, which is important for two reasons, Wang said. First, researchers are still uncertain which cancer biomarkers are the best diagnostic indicators. Secondly, detecting multiple biomarkers simultaneously will allow a doctor to diagnose more specifically the kind of cancer a patient may have.

Wang says the handheld device could be the smallest protein array reader in the world.

By means of magnets

The specialty of Wang's research group at Stanford is magnetic

nanotechnology. Magnetism is rare in biological systems, so any magnetic signal in a blood serum sample stands out like a flare in the night sky. By tagging cancer proteins with tiny magnetic particles, rather than electrically charged or glowing particles as in other detectors, the new system can obtain a clearer signal from a smaller number of cancer proteins.

At the heart of the detector is a silicon chip, designed by the paper's lead author, Sebastian Osterfeld, a Stanford materials science and engineering doctoral student. The chips have 64 embedded sensors that monitor for changes in nearby magnetic fields. Attached to these sensors are "capture antibodies," painstakingly selected by Heng Yu, formerly a postdoctoral fellow at Stanford Genome Technology Center, and Richard Gaster, a student in a combined program of doctorate and medical degrees.

The sensor's "capture antibodies" grab specific cancer-related proteins as they float by and hold onto them. Then a second batch of antibodies is added to the mix. They latch onto magnetic nanoparticles as well as the cancer biomarkers that are being held captive by the sensors. Thus when the MagArray sensors detect the magnetic field of nanoparticles, they've found cancer markers as well.

In the paper, the researchers estimate that they could detect levels of the human chorionic gonadotropin protein at a level about 400 times lower than the level required for detection by current commercial kits known by the acronym ELISA, in which captured cancer proteins are tethered to color altering or fluorescent labels.

At Stanford Medical Center, the detector is viewed as a potentially significant clinical advance, according to a diagnostics expert there.

"This work represents a giant leap forward in enabling technology for in vitro protein diagnostics with significant potential for many applications

including cancer detection and management," said Dr. Sam Gambhir, the principal investigator of the Center of Cancer Nanotechnology Excellence at Stanford.

Headed for hospitals?

To properly prepare a patient's blood sample for use with the detector, a technician must use a centrifuge to separate out the serum, which contains the biomarkers. For this reason, the device must be located in a hospital or a private diagnostic lab, Wang said. But before then it must face clinical testing and trials to win regulatory approval. To see the detector through those steps, Wang has co-founded a startup company, MagArray Inc., in the Panorama Institute for Molecular Medicine, a not-for-profit incubator in Sunnyvale, Calif.

The nascent startup is also investigating the possible use of the detectors in emergency rooms to quickly check for heart attacks when patients arrive with chest pains. Like cancer, heart cell death is associated with the release of specific biomarker proteins.

Provided by Stanford University