Hatice Altug: Diagnosing Disease

Portable biosensor detects viruses

By AMANDA DAVIS 5 March 2012

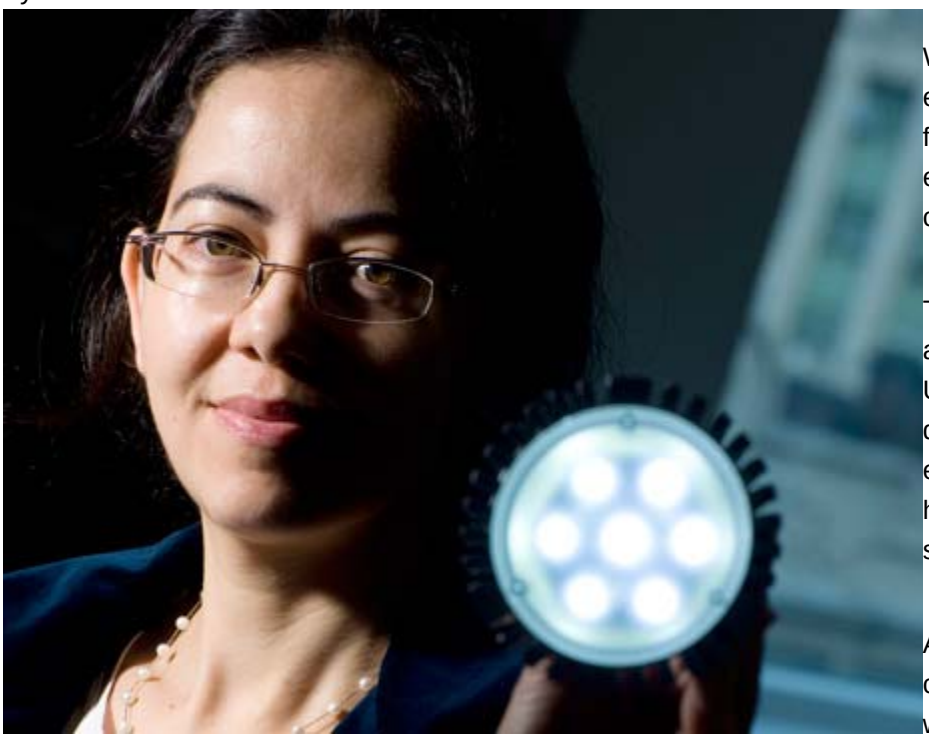

Photo: Boston University

When it comes to fighting off disease, early detection is key. But the technology for diagnosing some diseases can be expensive and unwieldy, and the process can be time-consuming.

That's where IEEE Member Hatice Altug and her research team at Boston University come in. They are working to develop a portable biosensor that eventually will help diagnose common human ailments such as food poisoning or swine flu faster and more easily.

An assistant professor of electrical and computer engineering at the school, Altug was recently recognized by U.S. president Barack Obama for her work on the sensor. In 2011, she was one of the recipients of the Presidential Early Career Award for Science and Engineers, an honor bestowed by the federal government on science and engineering professionals in the initial stages of their careers. She was cited for "advancing the frontiers of proteomics [the study of proteins] to enable the discovery of protein biomarkers for detection of disease, drugs, and environmental monitoring, and for innovative educational and outreach activities that have helped students at all levels."

The 33-year-old Altug received her Ph.D. in applied sciences from Stanford University in 2006, after getting her bachelor's degree in physics in 2000 from Bilkent University, in Ankara, Turkey.

IN THE LIGHT

To diagnose a patient's illness, doctors often take a sample of bodily fluid, send it to a laboratory, and wait for a technician's analysis. Altug and her team aim to streamline the process with their handheld sensor, which can detect viruses in less than 30 minutes.

Their device relies on a sensor chip consisting of a gold film about 100 nanometers thick, supported on a thin piece of glass. On the film are arrays of nanoapertures—holes measuring about 300 nm across—that transmit light. A charge-coupled device (CCD) at the other side of the holes detects the light sent through the film and monitors changes in the light's properties, including its resonant frequency.

To test their sensor, Altug and her team placed immobilized antibodies specific to the Ebola virus, a fatal virus that causes hemorrhagic fever, on the sensor's surface. The researchers then added a serum containing a safer, genetically modified version of the Ebola virus.

In general, the antibodies captured the virus in the sample, which is indicated by a shift in the resonant frequency of the light. This signals to the operator that a certain type of virus is present, based on the type of antibody used. The entire process has taken less than a half hour.

"We've also used our prototype to detect vaccinia, a surrogate virus of smallpox," she says. "Now we are starting to use it to detect other viruses, like the flu."

Altug has worked on the sensor since 2007, when she joined Boston University and helped form the **Laboratory of Integrated Nanophotonics and Biosensing Systems (http://people.bu.edu/altug/)**. The device has received attention from such organizations as the U.S. National Institutes of Health, which has given Altug and her collaborators at Boston University a US $4.8 million grant to develop it for commercial use. The group plans to work during the next five years to make the sensor more accurate and less expensive to manufacture.

Altug also garnered recognition last year from several associations and publications. For example, she received the **IEEE Photonics Society (http://photonicssociety.org/)**'s Young Investigator Award for her contributions to the sensor. She was named one of the *Popular Science* Brilliant 10 [October], and her work was featured in a *Lab on a Chip Journal* cover article [Royal Society of Chemistry, November].

EARLY EXPOSURE

Altug also dedicates a lot of her time to mentoring current and prospective engineering students, as well as their instructors. Since 2007 she has taught a seminar on nanophotonics and nanofabrication as part of Boston University's Upward Bound Math Science program. The program provides on-campus housing and intensive classes during the summer to low-income high school students.

Altug helped introduce the first engineering course for high schoolers in BU's Summer Challenge program in 2009. This program offers short but intensive courses to help students learn more about fields they plan to study in college.

She also works with preuniversity science teachers to incorporate nanotechnology and photonics into hands-on projects for their students. She says she wants to give students a taste of what attracted her originally to engineering: a penchant for building useful tools and gadgets.

"I realized early on that I could apply my creativity in a practical way if I studied physics and engineering," she says.

Developing health-care technology was particularly appealing because of its potential impact on society, she continues: "Our work can reduce the cost of diagnosing disease or even play a role in finding a cure for some. That is what motivates and inspires me."

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