

THE *Current*

July 16, 2003

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New Sensor Developed at UCSB Can Detect DNA in One Step

Imagine that your doctor, using a small hand-held sensor, could detect from a drop of your blood if you carry the gene for cystic fibrosis, or whether or not you have HIV. Or on the battlefield, a soldier could wear a small sensor that detects the smallest amount of anthrax in the air. In the food industry the same type of sensor could check for the DNA signature of salmonella.

Perhaps the most timely application of this new technology would be the possibility of providing immediate detection of biological weapons in civil defense, with sensors placed in airports, subways, post offices and similar settings.

Science is one step closer to this technology, thanks to research at the University of California, Santa Barbara, published this week in the Proceedings of the National Academy of Sciences.

The breakthrough comes from a collaboration of the laboratories of Kevin W. Plaxco, assistant professor of chemistry and biochemistry, and Nobel Laureate Alan J. Heeger, professor of physics and materials. The project was headed by postdoctoral researcher Chunhai Fan, first author of the paper.

"The goal is a DNA sensor that is simple, lightweight, low power and reusable," said Plaxco. "The target is to detect certain types of DNA. There are existing techniques that are incredibly sensitive, but they are slow and cumbersome and take hours to

days to complete."

For example, doctors now check for genes by using a several-hour technique known as PCR, or polymerase chain reaction.

Plaxco explained that the authors have developed an electronic detector for DNA based on a one millimeter electrode and electronics that can be held in the hand.

The detector is "reagentless," meaning that nothing needs to be added to get a reading. Currently all other electronic DNA detection approaches require that the DNA be treated with reagents in order to generate a signal.

"We've made an important step forward," said Plaxco.

"The sensitivity needs to be improved, however, before your doctor will want to carry one of these things around," he said. "While the sensitivity of the current device is competitive with the best existing technologies for the direct, electronic detection of DNA, no existing approach is sensitive enough to directly detect, say, strep in a throat swipe. Still, it has been shown that it is possible to detect single molecules by electrochemistry so there is no fundamental reason why our sensor cannot achieve the required sensitivity."

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