Scientists Peek Inside Living Cells With Tiny Electronics

By Michelle Bryner, TechNewsDaily Contributor
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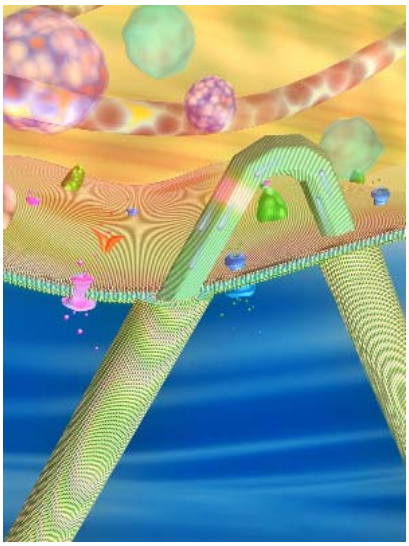

Tiny, hair-pinned shaped sensors penetrate biological cells. Credit: Charles Lieber, Harvard University

A new transistor that is smaller than the width of a human hair could be embedded into just about any cell, from brain to heart cells, allowing researchers to monitor a person's health on the go.

A common component of modern electronics, transistors enable the manipulation of electric signals in everything from computers to smartphones.

So far, the new nano-transistors have been used to peek inside of cultured heart cells – showing their ability to measure electrical changes without damaging the delicate cell.

Shaped like hairpins, yet thousands of times smaller, these little sensing devices consist of silicon nanowires with a transistor at the v-shaped tip. Their small size, as well as a coating that resembles a cell membrane, allows the little transistors to infiltrate human cells in the same way as viruses and bacteria.

This is the first time that a transistor has been used to probe inside of a human cell, replacing the old-school patch-clamp pipette technique, which has been used since the 1960s, said Charles Lieber, professor at Harvard University and co-author of the research.

While the patch-clamp method is useful, "that doesn't mean one can't do better," Lieber said.

He added, "It's almost amazing that someone hasn't figured out how to incorporate this really powerful device [the transistor], which has driven the computer age, with biology and biological measurements."

Nano kinks

Because transistors are typically flat, it's been tricky to use them as cell spies.

To overcome this dilemma, Lieber and his colleagues developed a process to grow nanowires with a 60-degree kink. By introducing various amounts of impurities during the growth process, the researchers were able to tailor the structure of the nanowires – giving the wire arms conductive characteristics so they could act as metal leads to connect to the outside world and semiconductive properties to the tip, which acts like a transistor for measuring changes in the cell.

Bio-digital hybrids

Initially, these tiny hairpins will be used in research labs to watch and record the inner workings of human cells. This probing could be used to determine the effect of a new drug on, for example, heart cells. But long-term, Lieber has other ideas, such as implanting these devices into the human body.

"What we're trying to do is … essentially merge and integrate [artificial] cardiac tissue or neural tissue or even stem cells with these nano-scale probes," Lieber said.

The goal is to "create this hybrid biological digital tissue" that could be implanted into the body, he added. This would allow the organs and cells to be monitored and if something's wrong a signal could be inputted to correct the medical problem, he said.

In an ongoing project, Lieber is working with Robert Langer, professor at MIT, to develop these hybrid tissues.

Lieber and his colleagues detail their findings in the August 13 issue of the journal *Science*.

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