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## NEWS

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## Team Develops Nanowire Rings

By **PIOTR BRZEZINSKI**

CONTRIBUTING WRITER

Harvard researchers have developed a breakthrough nanowire technology integrated into high-tech electronic circuits—which, among other things, could help manufacturers significantly decrease cell phone size.

Charles M. Lieber, Hyman professor of chemistry in the Faculty of Arts and Sciences, and Donhee Ham, assistant professor of electronic engineering in the Division of Engineering and Applied Sciences, led a interdisciplinary team of chemists and engineers on the project, which was described in the journal *Nature* last week.

Together, the researchers used miniature nanowires to build ring oscillators, which are a fundamental element of all digital electronics.

Developing an electronic circuit from nano-scale elements has long been a research goal, but previous attempts only managed to create circuits of 100 hertz frequency, which is too low for use in most applications.

Lieber and Ham's nanowire ring oscillators dramatically improved on previous attempts and achieved frequencies of 10 megahertz.

"The main development was making the first high-speed integrated circuits out of nanowires," said Lieber, "while most previous work on nanotubes had been focused on single devices or static measurements."

Lieber and Ham's advanced technology combines the high-tech performance of nanowires with an innovative, low-cost production process that uses common materials such as glass or plastic.

Unlike conventional fabrication processes, which rely on expensive silicon substrates, Lieber and Ham's process can use nanowires as if they were a solution and 'spray' them on any material.

Lieber said that the benefit is that "we can make high performance electronics on anything—we can even spray them on your pants. Moreover, as we continue to scale down, performance will go up."

Although scientists have been working with nanowires and nanotubes for years, Lieber and Ham were able to make use of recent research into the physics of nanowire performance. Ham noted that this breakthrough was only possible because of the collaboration between chemists and

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engineers. Lieber developed high-yield nanowires with unique organizational structures while Ham provided circuit design expertise and assembly techniques.

According to Ham, this technology can be applied to almost any communications device and "can be considered a complimentary alternative," to parts of current cell phone technology, allowing manufacturers to decrease cell phone size.

Lieber speculated that in the future, these developments could lead to high performance electronics with completely integrated displays, which combine pixel elements and driver electronics.

"Essentially, you could spray these things on a pattern and then hook up inputs and have display without needing inputs and drivers," Lieber said.

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