World's fastest method for transmitting information in cell phones and computers

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Demonstrating breakneck signal speed of 10 gigahertz, method uses nanotubes instead of conventional copper wires

UC Irvine scientists in The Henry Samueli School of Engineering have demonstrated for the first time that carbon nanotubes can route electrical signals on a chip faster than traditional copper or aluminum wires, at speeds of up to 10 GHz. The breakthrough could lead to faster and more efficient computers, and improved wireless network and cellular phone systems, adding to the growing enthusiasm about nanotechnology's revolutionary potential.

"Our prior research showed that nanotube transistors can operate at extremely high frequencies, but the connections between the transistors were made out of somewhat slower copper, thus forming a bottleneck for the electrical signals," said Peter Burke, assistant professor of electrical engineering and computer science, and one of the researchers who developed the technology. "In this technology we show that nanotubes can also quickly route electronic signals from one transistor to another, thus removing the bottleneck."

Electrical signals are routed at high speed through virtually all modern electronic systems and also through the airwaves in all modern wireless systems.

"From now on, any time a nanotube device is used anywhere in the world in a high-speed electronic device, computer, wireless network or

telephone system, people will benefit from this technology," Burke added.

A nanotube is commonly made from carbon and consists of a graphite sheet seamlessly wrapped into a cylinder only a few nanometers wide. A nanometer is one billionth of a meter, about the size of 10 atoms strung together.

Most of the layers of a modern semiconductor chip are dedicated to interconnect wiring, making the material used, and its speed, extremely important. The semiconductor industry recently shifted from using aluminum to copper as interconnects because copper carries electrical signals faster than aluminum. Based on Burke's work, it is now clear that changing the industry from copper to nanotubes would provide an even larger performance advantage in terms of speed. Before such a shift could occur, however, nanotube technology would need to be economical to manufacture and require precise assembly, a project Burke is currently working on.

Previous work by the Burke team demonstrated that nanotubes can carry electrical signals up to several millimeters across a chip better than copper, but did not measure how fast the signals propagate. This work is the first interconnect-technology demonstration for ultra-high-speed applications. Now that Burke's team has developed both high-speed nanotube-interconnect technology and high-speed nanotube-transistor technology, they hope to integrate the two into an ultra-high-speed all-nanotube electronic circuit, faster than any existing semiconductor technology.

Burke conducted the research along with graduate student Zhen (Jenny) Yu. The findings have been reported in the June 2005 issue of Nano Letters, a peer-reviewed journal of the American Chemical Society, the world's largest scientific society.

The Army Research Office, the Office of Naval Research, the Defense Advanced Research Projects Agency and the National Science Foundation provided funding for the research, which took place at UCI's Integrated Nanosystems Research Facility in The Henry Samueli School of Engineering.

Source: About the University of California, Irvine