Stanford researchers demonstrate carbon nanotube based computer chip

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(Phys.org)—A research team from Stanford University led by associate professor Subhasish Mitra and headed by Professor Philip Wong, has demonstrated a computer chip based on transistors made out of carbon nanotubes. The demonstration took place at this year's International Solid-State Circuits Conference held in San Francisco.

Transistors have of course, been getting smaller over the past few decades as engineers attempt to pack more computing power onto chips small enough to fit onto smartphones and other electronic devices. There is a limit, though, to how small such circuits can be made using silicon—the material upon which modern computers are built. For that reason, researchers have been looking for alternative materials that can be used instead—materials that can do the same thing as silicon but at a much smaller size. Transistors of today fall roughly in the 20nm range—engineers want to reduce that by half, or better, but trying to do so using silicon won't be possible because of the limited number of atoms in silicon molecules.

To create transistors of the future, researchers have been looking at semiconducting carbon nanotubes—they're highly conductive, can be fashioned at a much smaller size than silicon, and can switch at very high speeds. Currently the hold-up is in figuring out how to grow them without a high error rate. The best methods currently produce nanotubes in bunches where up to 30 percent of them are metallic instead of semiconducting—which is of course unacceptable for use in making computer chips. Or at least that's been the conventional thinking. By demonstrating a functional computer chip based on carbon nanotubes, the team from Stanford has shown that it might be possible to work around such error rates.

The reason error rates for nanotubes are so high is because of the way they come about—they're grown, like crystals, rather than fabricated, and like everything else that grows, there are imperfections—thus at this time there doesn't seem to be a way around the problem. Even worse, they don't grow in nice smooth lines—instead they have curves and bend around which tend to present problems in connecting them together and add to switching irregularities. Because of these problems the researchers took another approach—instead of trying to get the nanotubes to grow in more predictable ways, they put them together in such a way as to correct for the errors that result when grouped as a transistor.

The team didn't give specific details on how they corrected the errors produced by the nanotubes but they demonstrated it had been done by building a chip that was able to convert an analog signal to a digital one—it's a very common computer function, such as converting finger swipes on a smartphone to signals the processor can understand. At the conference, the team connected their chip to a hand made out of wood, that when touched, responded by simulating shaking hands.

By creating a nanotube based computer chip the team has demonstrated it can be done—what still remains to be seen however, is whether research in the future will lead to scaling that will allow for their use in actual computers.

More information: www.stanford.edu/~hspwong/

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