NewScientistTech



# Nanowire transistors outperform silicon switches

18:00 24 May 2006
NewScientist.com news service
Kurt Kleiner

Nanowire transistors made from silicon and germanium have been found to outperform conventional silicon ones. As transistors are the crucial switches used to control electronic circuitry this marks a key step towards super-fast nanoscale computing.



Charles Lieber and colleagues at Harvard University in Massachusetts, US, created the transistors using wires just 18 nanometres (billionths of a metre) in diameter. The wires consist of a germanium core coated with a layer of silicon. The researchers then used an electric field to control the nanowires' conductivity. This allowed them to switch a current passing through the wires on and off.

Lieber's team call the components nanowire field-effect transistors (NWFETs). They are analogous to the metal oxide semiconductor field-effect transistors (MOSFETs) used in conventional silicon chips.

### Half the size

Each nanowire transistor is about half the size of the smallest silicon transistor and could theoretically be used to pack more processing power onto the same area of microchip. Lieber's team found that the nanowire components also performed better than conventional MOSFETs in several important benchmarks.

These included measures of the amount of current the wires could conduct, the speed with which they could be switched on and off and their sensitivity to the applied electric field. The NWFETs were two to three times better than MOSFETs in each case.

"Our results, combined with their unique small size will make the nanowires interesting for a range of electronic applications in the future," Lieber told **New Scientist**. He adds that the wires will function on a variety of different substrates, offering flexibility to chip designers.

Nano-transistors have previously been made using carbon nanotubes. But these are difficult to make uniformly and hard to integrate with other electronic components.

### Reproducible features

Lieber says silicon-germanium nanowires can be grown in large numbers with highly reproducible features. His team used a method called vapor-liquid-solid synthesis to make them. They exposed germanium tetrahydride gas to a catalyst of gold nanoparticles, causing a solid crystal wire to grow.

"For the first time we're really seeing excellent room temperature performance," says Mark Lundstrom, an independent expert from Purdue University in Indiana, US. "This is what's been missing for a lot of us. All of the pieces haven't been put together before."

Lundstrom agrees that the wires should be easier to use than carbon nanotubes. But he notes that carbon nanotubes are smaller still - about 1 or 2 nanometres in diameter - and so might have potential applications.

Lieber says that the next step is to shrink the length of the nanowires. Although just 18 nm in diameter, the shortest wire is currently about 200 nm long.

Journal reference: *Nature* (vol 441, p 489)

### Related Articles

Y-shaped nanotubes are ready-made transistors
http://www.newscientisttechnology.com/article/dn7847
15 August 2005

Controllable nano-diode created
http://www.newscientisttechnology.com/article/dn6126
08 July 2004

Nano-transistor self-assembles using biology
http://www.newscientisttechnology.com/article/dn4406
20 November 2003

### Weblinks

Lieber Research Group, Harvard University
http://cmliris.harvard.edu/

Mark Lundstrom, Purdue University
http://www.ece.purdue.edu/~lundstro/