

Nanobridges Show Way to Nano Mass Production

April 7 2005

They look like an elegant row of columns, tiny enough for atomic-scale hide-and-seek, but these colonnades represent a new way to bring nanotechnology into mass production.

[Nanotechnology](#), the ability to create and work with structures and materials on an atomic scale, holds the promise of extreme miniaturization for electronics, chemical sensors and medical devices. But while researchers have created tiny [silicon](#) wires and connected them together one at a time, these methods cannot easily be scaled up.

"It takes weeks to make one or two, and you end up with different sizes and characteristics," said M. Saif Islam, assistant professor of electrical and computer engineering, who joined UC Davis from Hewlett-Packard Laboratories in 2004.

Like handmade shoes, every manually assembled nanostructure comes out slightly different. Engineers would rather build devices the way cars or computers are built, with every item as consistent as possible.

While working at the Quantum Science Research group of Hewlett-Packard Laboratories, Islam and colleagues came up with a new approach. Silicon wafers used for building microcircuits are usually polished at one specific angle to the atomic planes of silicon. Instead, the group used a wafer that was polished at a different angle, changing the orientation of silicon atomic planes to the surface. Using a chemical vapor deposition technique, they could then grow identical, perpendicular columns of silicon.

The researchers have used this method to grow "nanobridges" across a gap between two vertical silicon electrodes. The nanobridges are strong, chemically stable and show better electrical properties than previous approaches, Islam said. They could be used for nanosized transistors, chemical sensors or lasers.

Taking the approach a step further, Islam and his colleagues at Hewlett-Packard made sandwiches of silicon and insulator and partly etched away the top layer to create awning-shaped structures of silicon supported by insulator. Silicon columns grown under the awnings form miniature colonnades.

The method allows engineers to combine nanowires of precise length with other silicon structures such as integrated circuits, he said.

At UC Davis, Islam plans to continue work on converting the technology into practical devices. The "nanobridge" technique was reported most recently in the March 2005 issue of the journal Applied Physics Part A. The nanocolonnade work was presented April 1 at the spring meeting of the Materials Research Society in San Francisco.

Source: UC Davis

Citation: Nanobridges Show Way to Nano Mass Production (2005, April 7) retrieved 24 April 2024 from <https://phys.org/news/2005-04-nanobridges-nano-mass-production.html>

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