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Future advances: Stretchable silicon-based electronics

WASHINGTON - A team of researchers at the University of Illinois at Urbana-Champaign have come up with stretchable silicon, which could usher in a new era in the electronics segment. The researchers have managed to create a stretchable form of "single-crystal silicon with micron-sized, wave-like geometries" meaning that future electronics devices can be built on "rubber substrates."

The researchers have detailed their efforts in the current issue of the journal Science. The practical uses of stretchable and functional electronics are many. From creating sensors and drive electronics that can perform a variety of roles in artificial muscles to building foldable monitors for aircraft wings, this development signals exciting times ahead for the electronics industry.

"Stretchable silicon offers different capabilities than can be achieved with standard silicon chips," said John Rogers, who is the professor of materials science and engineering and a co-author of the current paper. To achieve the goal of "bending" silicon as it were, researchers' initially mould the device on an ultrathin silicon wafer.

While this process is being activated, the silicon is undercut resulting in the characteristic wavy pattern that makes it a suitable base for the main device. After this a rubber substrate is stretched onto the "silicon ribbons" and then peeled away. When the stress is ultimately released, the silicon and rubber resemble wavy geometrical patterns. "The resulting system of wavy integrated device elements on rubber represents a new form of stretchable, high-performance electronics.

The amplitude and frequency of the waves change, in a physical mechanism similar to an accordion bellows, as the system is stretched or compressed," said Young Huang, a professor in Mechanical and Industrial engineering and a co-author of the paper. The researchers have used this concept to create wavy diodes and transistors, which work better than the traditional devices in some aspects.

"In addition to individual devices, complete circuit sheets can also be structured into wavy geometries to enable stretchability," Rogers commented adding that the diodes and transistors were but one class of devices where the "stretch" principle could be applied.

Written by : Paco Tyee | Published on : 18:33:00 EST Sun, 18 Dec 2005

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