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Nanowires get connected

Nickel vapour creates tiny transistor network.

1 July 2004

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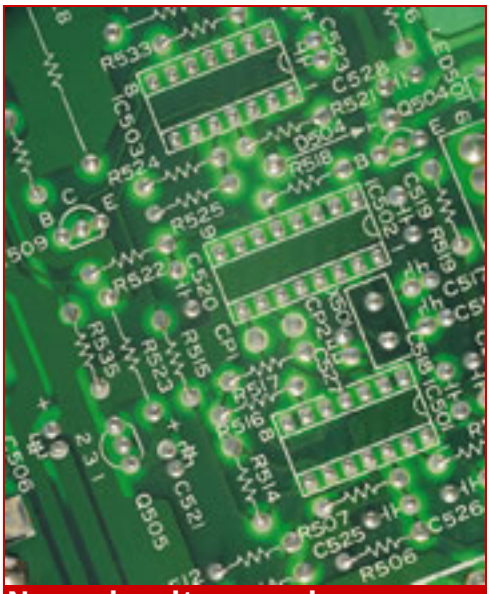

Nanocircuits promise electronic chips that are hundreds of times smaller than this.
© Getty Images

Molecule-sized switches regularly prompt headlines about a new generation of miniaturized electronic chips. But there's a catch.

Although researchers can shrink individual components of circuits to the nanoscale, they cannot wire them together without conventional connections, which are hundreds of times bigger than the components themselves.

It's akin to joining the latest Pentium chip to your computer with enormous crocodile clips and jump leads. "You lose most of the advantages you had in this very small structure," says Charles Lieber, a chemist from Harvard University, Massachusetts.

Now Lieber reckons he has the answer: a technique that could be used to create ready-wired nanocircuits that do not need cumbersome connections.

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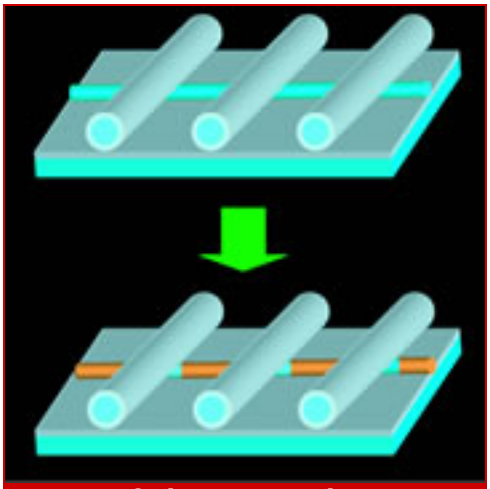
Computer circuits are built from transistors, which are a type of switch that allows a current to flow or shut it off; a transistor is made up of a piece of semiconducting material sandwiched between two slices of conductive material. Lieber's secret lies in transforming sections of a semiconducting silicon nanowire into nickel silicide, a good electrical conductor.

Scientists can already make minuscule silicon wires that are just 10 nanometres wide, or 10,000 times thinner than a sheet of paper. Lieber's team covered one of these nanowires with a temporary mask that obscured alternating sections. Then they blasted the wire with nickel vapour, which transformed the uncovered sections into nickel silicide (see Diagram).

The resulting structure was equivalent to a string of transistors, all pre-connected by conducting nickel silicide, the researchers report in this week's Nature[1].

Detecting a niche

At this stage the chain does not actually do anything useful. "But it's an important proof of principle," says Lieber. He says that by applying a more elaborate mask to a woven network of silicon nanowires it should be possible to create complex circuits in one go.



Areas of the nanowire not covered by the mask are converted into nickel silicide.

To prove his point, he hopes to make a much more sophisticated structure that can perform complex calculations. "We're trying to make a programmable series of literally thousands of these transistors."

Such devices are unlikely to compete directly with the well-established semiconductor industry any time soon. Instead, Lieber thinks they will find niches that exploit their extreme sensitivity. For example, a nanotransistor network could be triggered by the electrical charge carried by a single protein, forming a powerful detection system.

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References

1. Wu, Y. , Xiang, J., Lu, W., Lieber, C.M. *Nature*, 61 - 65, **429,**. (2004). **|Article|**