Spider Silk Could Find Use in Biodegradable Computer Chips

Spiders and some insects use silk to build strong webs and spin cocoons, and now scientists have figured out how to use the material for something even more amazing: electronic computer chips.

Many will have read reports that spider silk is a sort of supermaterial [1]: stronger than steel, tougher than Kevlar, and yet incredibly malleable and flexible. But the silk has other properties that make it ideal for use in electronic devices. Light can travel through a silk strand as easily as it does through a fibre optic cable.

"When we first tested spider silk, we didn't know what to expect," said physicist Nolwenn Huby of the Institut de Physique de Rennes in France. "We thought, 'Why not try this as an optical fibre to propagate light?'"

Huby and her team were able to transmit laser light down a short strand of the silk on an integrated circuit chip. The silk worked much like glass fibre optic cables, meaning it could carry information for electronic devices, though it had about four orders of magnitude more loss than the glass. Huby said that with a coating and further development, the silk could one day have better transmission capabilities. She will present her results at this year's Frontiers in Optics [2] conference, 14-18 October in Rochester, New York.

The achievement could open the door to medical applications, such as silk fibres carrying light to places in the body for internal imaging. Because spider silk is incredibly thin -- roughly five microns in diameter or 10 times thinner than a human hair -- surgeons could perform diagnostic exams using very small openings in the body.

"These materials are harmless, so you can implant them," said biomedical engineer Fiorenzo Omenetto [3]of Tufts University in Somerville, Massachusetts, who has been working in this field for years and will also be giving a talk on opportunities for silk in high-tech products at Frontiers in Optics. "The body has no reaction to them."

Omenetto envisions future applications [4] where, after a medical procedure, doctors and surgeons place a silk bandage in a patient embedded with electronic functions to monitor for possible infections. The patient can be closed up and then never have to worry about having the monitoring device taken out again because the body will simply absorb the material. Already his team has developed a small implantable radio frequency heater that could sterilise an area against bacteria.

For his applications Omenetto uses silkworm silk -- the kind you find in fancy clothing, ties, and underwear. It shares many of the same properties as spider silk

but can be manufactured on an industrial scale. Silkworms can be grown close together and produce copious silk fibres while spiders need lots of space, are often cannibalistic of their neighbours, and produce fewer quantities of silk.

Omenetto simply takes the silk from textiles and boils it in water to extract the silky proteins. His team is able to use this mixture to produce a sort of plastic that is 100 percent natural. Because it is fully biodegradable, electronic silk technology could potentially become widespread. By doping materials with silk, Omenetto's team has created a device that can shoot a blue laser beam. The gadget's components are fully compostable and also use less power than equivalent acrylic laser shooters.

With a great deal of further development, e-waste could be a thing of the past. Whenever a new snazzy mobile phone comes out, you could simply compost your old model instead of leaving it to languish in a tip, slowly leaching toxic chemicals [5]. But such electronics are still decades away, said Omenetto. Compostable circuits are one thing but engineers would still need to figure out how to make biodegradable batteries, interfaces, and everything else in modern-day electronics, he added.

"We have to be very realistic about these things," he said.

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