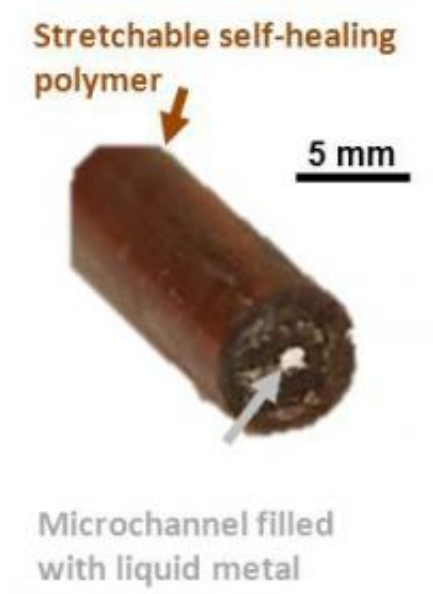
Researchers create self-healing, stretchable wires using liquid metal

January 23 2013, by Dr. Michael Dickey



Researchers from North Carolina State University have developed elastic, self-healing wires in which both the liquid-metal core and the polymer sheath reconnect at the molecular level after being severed. Credit: Michael Dickey, North Carolina State University

(Phys.org)—Researchers from North Carolina State University have developed elastic, self-healing wires in which both the liquid-metal core and the polymer sheath reconnect at the molecular level after being severed.

"Because we're using liquid metal, these wires have excellent conductive properties," says Dr. Michael Dickey, an assistant professor of chemical and biomolecular engineering at NC State and co-author of a paper on the work. "And because the wires are also elastic and self-healing, they have a lot of potential for use in technologies that could be exposed to high-stress environments."

The researchers first created tiny tunnels, called microfluidic channels, in a commercially available self-healing polymer using solid wire. By filling those channels with a liquid-metal alloy of indium and gallium, they were able to create a liquid-metal wire in an elastic sheath. Because the wire is liquid, it can be stretched along with the polymer sheath.

When the wires are sliced or severed, the liquid metal oxidizes – forming a "skin" that prevents it from leaking out of its sheath. When the severed edges of the wire are placed back together, the liquid metal reconnects and the sheath re-forms its molecular bonds.

"We're also excited about this work because it allows us to create more complex circuits and rewire existing circuits using nothing more than a pair of scissors by cutting and reconfiguring the wires so that they connect in different ways," Dickey says.

Similarly, the technique developed by Dickey's team could be used to create complex, three-dimensional structures with connecting microfluidic channels, by cutting the polymer sheath into sections and reconnecting them at different angles with the channels still in alignment.

The paper, "Self-Healing Stretchable Wires for Reconfigurable Circuit Wiring and 3D Microfluidics," is published online in *Advanced Materials*.

More information: "Self-Healing Stretchable Wires for Reconfigurable Circuit Wiring and 3D Microfluidics", Online Jan. 18 in Advanced Materials . onlinelibrary.wiley.com/doi/10 … a.201203921/abstract

Abstract
This paper describes the fabrication of stretchable wires with metallic conductivity that can self-heal both mechanically and electrically after being severed completely. The wires consist of liquid metal injected into microchannels composed of self-healing polymer. Self-healing wires improve the durability of electronic components and are particularly important for the growing field of stretchable electronics in which electronic components may undergo significant deformation. In addition, these self-healing structures offer a new way to rewire circuits and a simple method of reconfiguring microfluidic channels into more complex shapes using nothing more than scissors. This work combines synergistically the unique properties of gallium-based alloys with self-healing polymers, which are motivated primarily by the desire to reduce replacement and recycling costs for plastics.

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