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Researchers use liquid metal to create wires that stretch eight times their original length

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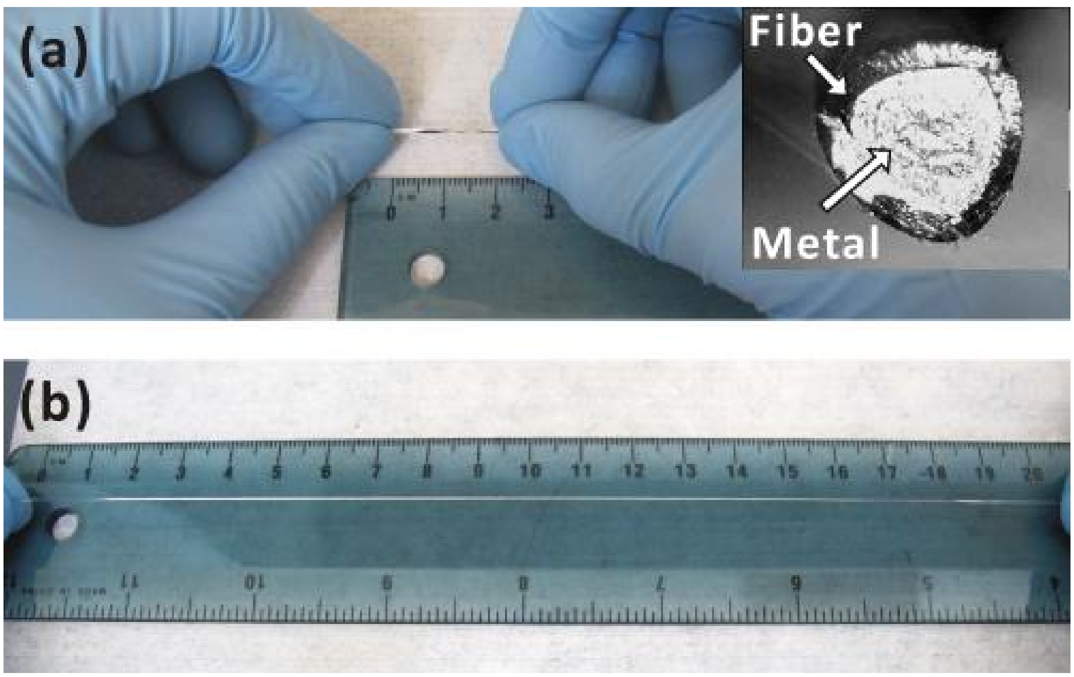

The tube, filled with liquid metal, can be stretched many times its original length. Credit: Dr. Michael Dickey, North Carolina State University

(Phys.org)—Researchers from North Carolina State University have created conductive wires that can be stretched up to eight times their original length while still functioning. The wires can be used for everything from headphones to phone chargers, and hold potential for use in electronic textiles.

To make the wires, researchers start with a thin tube made of an extremely elastic polymer and then fill the tube with a liquid metal alloy of gallium and indium, which is an efficient conductor of electricity.

"Previous efforts to create stretchable wires focus on embedding metals or other electrical conductors in elastic polymers, but that creates a trade-off," says Dr. Michael Dickey, an assistant professor of chemical and biomolecular engineering at NC State and co-author of a paper on the research.

"Increasing the amount of metal improves the conductivity of the composite, but diminishes its elasticity," Dickey says. "Our approach keeps the materials separate, so you have maximum conductivity without impairing elasticity. In short, our wires are orders of magnitude more stretchable than the most conductive wires, and at least an order of magnitude more conductive than the most stretchable wires currently in the literature."

While the manufacturing of the new wires is relatively straightforward, Dickey notes that one challenge needs to be addressed before the wires can be considered for popular products: how to minimize leakage of the metal if the wires are severed.

The paper, "Ultrastretchable Fibers with Metallic Conductivity Using a Liquid Metal Alloy Core," is published online in Advanced Functional Materials.

More information: "Ultrastretchable Fibers with Metallic Conductivity Using a Liquid Metal Alloy Core" Authors: Shu Zhu, Ju-Hee So, Robin Mays, Sharvil Desai, William R. Barnes, Behnam Pourdeyhimi, Michael D. Dickey. Published: online Dec. 13, *Advanced Functional Materials.*

Abstract
This paper describes the fabrication and characterization of fibers that are ultra-stretchable and have metallic electrical conductivity. The fibers consist of a liquid metal alloy, eutectic gallium indium (EGaIn), injected into the core of stretchable hollow fibers composed of a triblock copolymer, poly[styrene-b-(ethylene-co-butylene)-b-styrene] (SEBS) resin. The hollow fibers are easy to mass-produce with controlled size by using commercially available melt processing methods. The fibers are similar to conventional metallic wires (metal core, surrounded by polymeric insulation), but can be stretched orders of magnitude further while retaining electrical conductivity. Mechanical measurements with and without the liquid metal inside the fibers show the liquid core has a negligible impact on the mechanical properties of the fibers, which is in contrast to most conductive composite fibers. The fibers also maintain the same tactile properties with and without the metal because the conductive elements are confined to the core of the fiber. As expected, electrical measurements show that the fibers increase resistance as the fiber elongates and the cross sectional area narrows. Fibers with large diameters (~600 [micrometers]) change from a triangular to a more circular cross-section during stretching, which has the appeal of lowering the resistance below that predicted by theory. The ability of the liquid metal to flow during the elongation of the fibers results in electrical continuity up to 1000% strain and metallic conductivity (~3×10-5 [Omega] cm) up to 700% strain. As a demonstration of their utility, the ultrastretchable fibers were used as the wires for stretchable earphones and a stretchable battery charger.

Provided by North Carolina State University wires-length.html