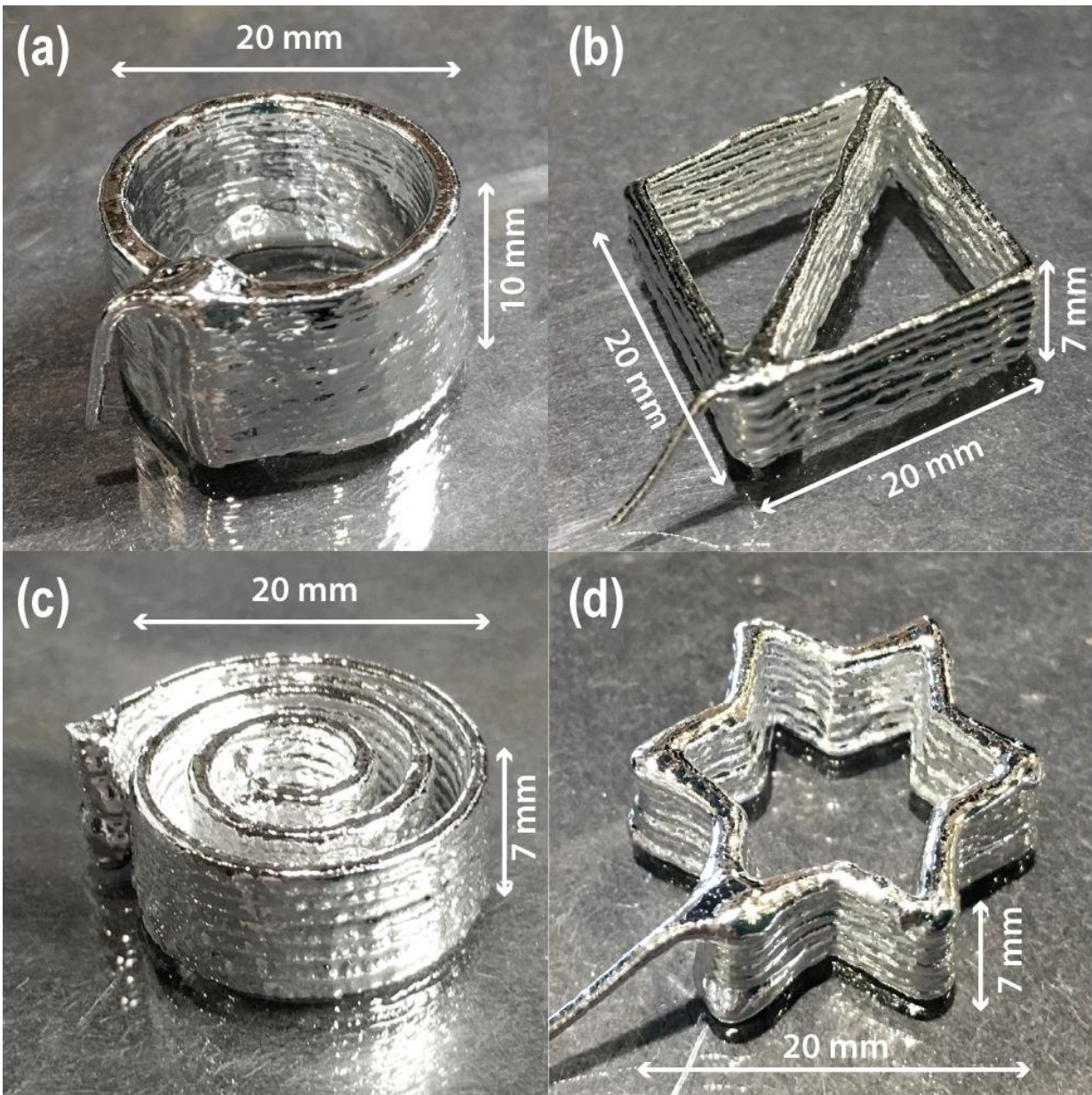


# Modified, 3D-printable alloy shows promise for flexible electronics, soft robots

March 5 2018, by Steve Lundeberg



Credit: Oregon State University

Researchers in Oregon State University's College of Engineering have taken a key step toward the rapid manufacture of flexible computer screens and other stretchable electronic devices, including soft robots.

The advance by a team within the college's Collaborative Robotics and Intelligent Systems Institute paves the way toward the 3D printing of tall, complicated structures with a highly conductive gallium alloy.

Researchers put nickel nanoparticles into the [liquid metal](#), galinstan, to thicken it into a paste with a consistency suitable for [additive manufacturing](#).

"The runny alloy was impossible to layer into tall structures," said Yi?it Mengüç, assistant professor of mechanical engineering and co-corresponding author on the study. "With the paste-like texture, it can be layered while maintaining its capacity to flow, and to stretch inside of rubber tubes. We demonstrated the potential of our discovery by 3D printing a very stretchy two-layered circuit whose layers weave in and out of each other without touching."

Findings were recently published in *Advanced Materials Technologies*.

Gallium alloys are already being used as the conductive material in [flexible electronics](#); the alloys have low toxicity and good conductivity, plus they're inexpensive and "self-healing" - able to attach back together at break points.

But prior to the modification developed at OSU, which used sonication - the energy of sound - to mix the nickel particles and the oxidized gallium

into the liquid metal, the alloys' printability was restricted to 2-dimensional.

For this study, researchers printed structures up to 10 millimeters high and 20 millimeters wide.

"Liquid metal printing is integral to the flexible electronics field," said co-author Doğan Yirmibeolu, a robotics Ph.D. student at OSU.

"Additive manufacturing enables fast fabrication of intricate designs and circuitry."

The field features a range of products including electrically conductive textiles; bendable displays; sensors for torque, pressure and other types of strain; wearable sensor suits, such as those used in the development of video games; antennae; and biomedical sensors.

"The future is very bright," Yirmibeolu said. "It's easy to imagine making [soft robots](#) that are ready for operation, that will just walk out of the printer."

The gallium alloy paste demonstrates several features new to the field of flexible electronics, added co-corresponding author Uranbileg Daalkhaijav, Ph.D. candidate in chemical engineering.

"It can be made easily and quickly," Daalkhaijav said. "The structural change is permanent, the electrical properties of the paste are comparable to pure liquid metal, and the paste retains self-healing characteristics."

Future work will explore the exact structure of the paste, how the nickel particles are stabilized, and how the structure changes as the paste ages.

**More information:** Uranbileg Daalkhaijav et al, Rheological

Modification of Liquid Metal for Additive Manufacturing of Stretchable Electronics, *Advanced Materials Technologies* (2018). [DOI: 10.1002/admt.201700351](https://doi.org/10.1002/admt.201700351)

Provided by Oregon State University

Citation: Modified, 3D-printable alloy shows promise for flexible electronics, soft robots (2018, March 5) retrieved 4 April 2024 from <https://techxplore.com/news/2018-03-3d-printable-alloy-flexible-electronics-soft.html>

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