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Super-semiconductors show ultra-low resistivity FREE

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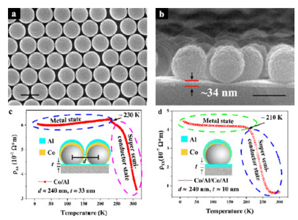
With a resistivity three to ten orders of magnitude lower than conventional semiconductors at room temperature, the devices could significantly reduce power consumption in electronics.



Within the range of solid-state electrical conducting materials, superconductors reach resistances near zero, while insulators prevent the flow of electricity. In between, semiconductors form the foundation of modern electronics. Manufacturing semiconductors with low resistivity will improve diode, transistor, integrated circuit, and chip performance by reducing power consumption.

To this end, Li et al. developed a super-semiconductor with a resistivity low enough to provide a basis for ultra-low-power electronic devices.

"In this paper, we reported unparalleled resistivity in nanostructured bimetallic arrays, which show semiconductor behavior and three to ten orders of magnitude lower resistivity than that of a conventional semiconductor like silicon," said author Bingqing Wei. "To distinguish it from conventional semiconductors and analog superconductors, we named it a super-semiconductor."

The team prepared a self-assembled polystyrene template as a substrate for the arrays. A 10-nanometer-thick cobalt layer was sputtered on the template, and a 100-nanometer-thick aluminum layer was deposited shortly thereafter.

The transport properties of the device were measured with a standard physical property measurement system, and the magnetic properties were characterized by a superconducting quantum interference device. The group also recorded the infrared light absorption of the samples.

At high enough ambient temperatures (above 210 Kelvin), the nanostructured bimetallic arrays would transfer from a metallic state to a semiconducting state without additional energy sources.

"We will conduct more comprehensive measurements in the future, and we are currently designing a super-semiconductor P-N junction to test its device performance," said Wei.

In addition to improving electronic device performance, the researchers hope their work will encourage other scientists to explore the unusual properties of nanostructured metals.

Source: "Plasmon-induced super-semiconductor at room temperature in nanostructured bimetallic arrays," by Zhigang Li, Xiangke Cui, Xiaowei Wang, Zongpeng Wang, Minghu Fang, Shangshen Feng, Yanping Liu, Jigen Chen, Tianle Wang, Hengjie Liu, Zhenhai Xia, and Bingqing Wei, *Applied Physics Reviews* (2022). The article can be accessed at https://doi.org/10.1063/5.0087808.