

An Invisibility Cloak with Internal Invisibility

A new metamaterial design eliminates internal distortions that can adversely affect applications in cloaking and sensing.

By **Michael Schirber**

Invisibility cloaks are not limited to magicians; physicists have created so-called metamaterials that can prevent light (or sound or heat) from scattering off an enclosed object. But one potentially unwanted consequence of this effect is that the underlying field is distorted inside the metamaterial cloak. Researchers have now designed a metamaterial shell that lets heat pass through it smoothly [1]. “The result is that the temperature field looks as if the device is not there at all—both outside and inside the shell,” says Jiping Huang from Fudan University in China. The approach could be applied to noninvasive sensors and to thermal isolation for quantum circuits.

Metamaterials are made up of many small elements that are tailored to interact with a surrounding field in a desired way. A thermal cloak, for example, has elements that conduct heat around an object. The typical design, however, can produce strong temperature distortions within the cloak. To avoid this, Huang and colleagues came up with a new design, one in which the thermal conductivity varies strongly within the

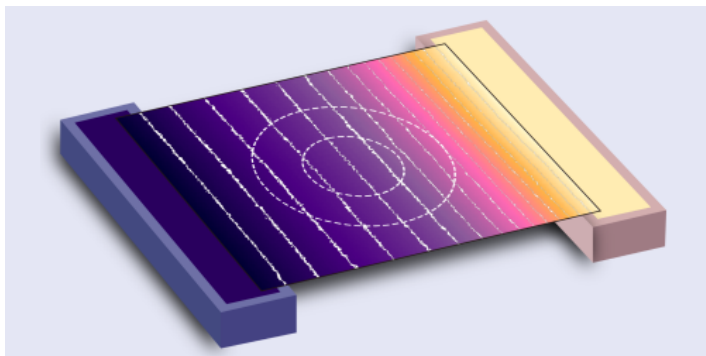
metamaterial.

To realize this design, the researchers used machine learning. They started with a generic metaelement shape that included holes for reducing conductivity and fins for boosting conductivity. The machine-learning program determined the shape parameters for a cloak (to hide an object), as well as for a sensor (to measure without disturbing) and a concentrator (to enhance a field). Using metal plates, the team fabricated these metadevices and placed them between hot and cold baths. The measured temperature profiles showed nearly zero distortions within the metamaterial. Besides thermal control, Huang says the procedure might improve metamaterial designs for acoustics and optics.

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REFERENCES

1. Y. Zhang *et al.*, “Dual-zero-scattering in diffusive transport,” *Phys. Rev. Lett.* **136**, 196901 (2026).



Credit: J. Huang/Fudan University