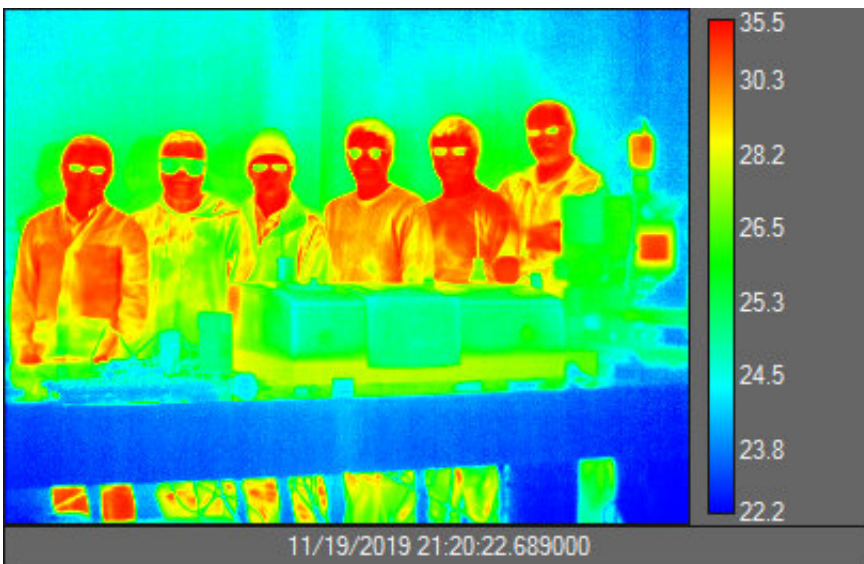


# New coating hides temperature change from infrared cameras

December 18 2019, by Renee Meiller



Taken with a long-wave infrared camera, this image of researchers in Mikhail Kats' lab shows distinct color variations across areas that are warmer (faces and bodies) and cooler (the table). Credit: the Kats group

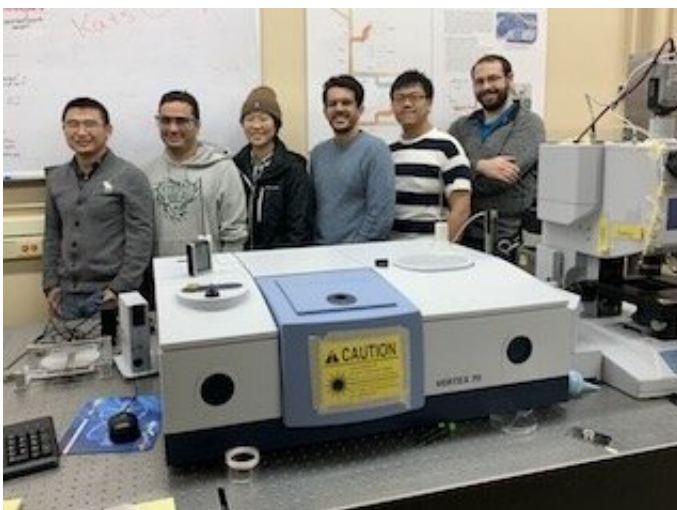
An ultrathin coating developed by University of Wisconsin-Madison engineers upends a ubiquitous physics phenomenon of materials related to thermal radiation: The hotter an object gets, the brighter it glows.

The new coating—engineered from samarium nickel oxide, a unique tunable material—employs a bit of temperature trickery.

"This is the first time temperature and thermal light emission have been decoupled in a solid object. We built a coating that 'breaks' the relationship between temperature and thermal [radiation](#) in a very particular way," says Mikhail Kats, a UW-Madison professor of electrical and computer engineering. "Essentially, there is a temperature range within which the power of the thermal radiation emitted by our coating stays the same."

Currently, that temperature range is fairly small, between approximately 105 and 135 degrees Celsius. With further development, however, Kats says the coating could have applications in [heat transfer](#), camouflage and, as [infrared cameras](#) become widely available to consumers, even in clothing to protect people's [personal privacy](#).

Kats, his [group members](#), and their collaborators at UW-Madison, Purdue University, Harvard University, Massachusetts Institute of Technology and Brookhaven National Laboratory published details of the advance this week in the *Proceedings of the National Academy of Sciences*.

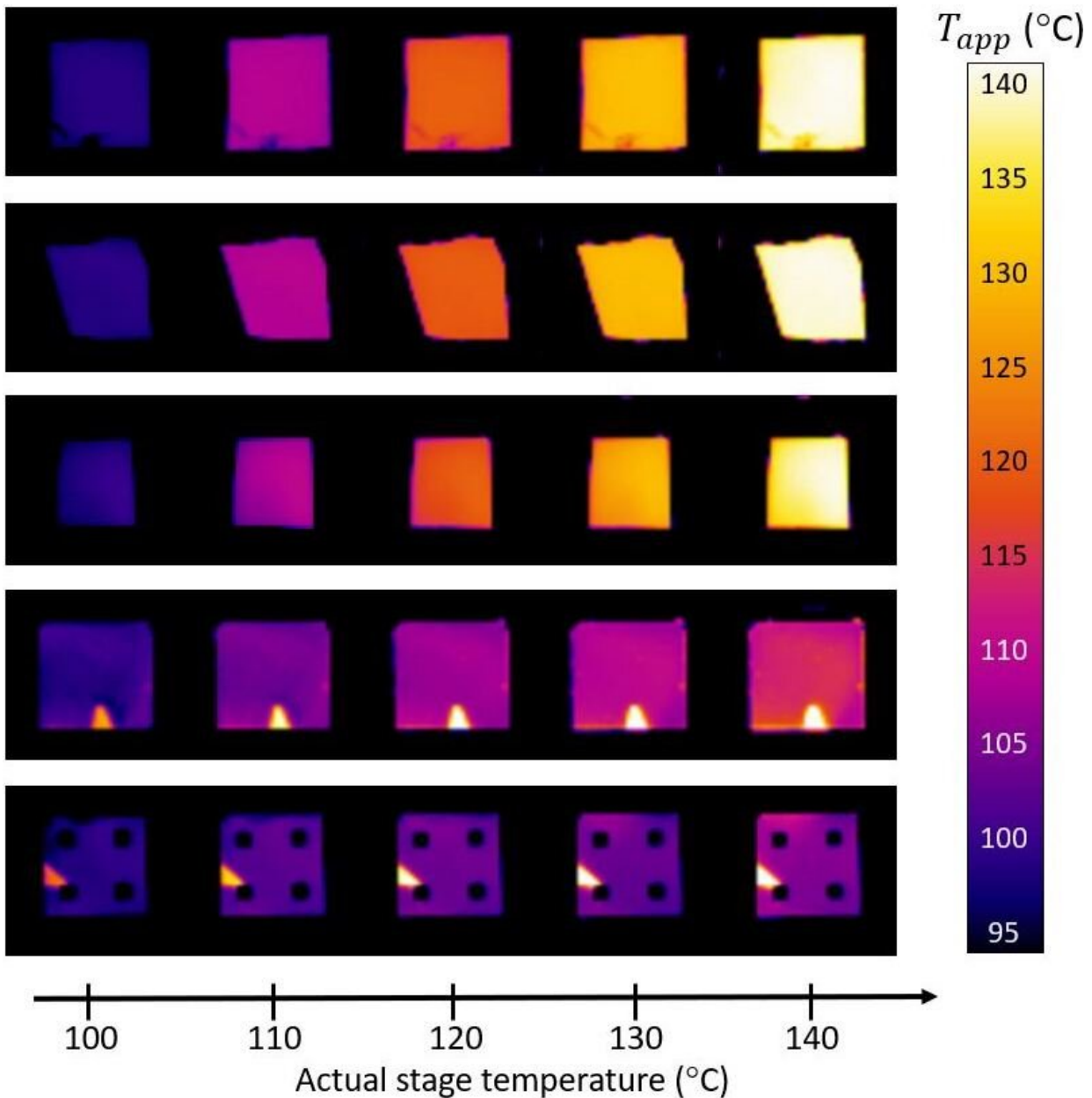


Members of the UW team who contributed to the work include postdoctoral

scholar Yuzhe Xiao, and graduate students Alireza Shahsafi, Zhaoning (April) Yu, Jad Salman, Chenghao Wan and Ray Wambold. Credit: Renee Meiller

The coating itself emits a fixed amount of thermal radiation regardless of its temperature. That's because its emissivity—the degree to which a given material will emit light at a given temperature—actually goes down with temperature and cancels out its intrinsic radiation, says Alireza Shahsafi, a doctoral student in Kats' lab and one of the lead authors of the study.

"We can imagine a future where infrared imaging is much more common, negatively impacting personal privacy," Shahsafi says. "If we could cover the outside of clothing or even a vehicle with a coating of this type, an infrared camera would have a harder time distinguishing what is underneath. View it as an infrared privacy shield. The effect relies on changes in the optical properties of our coating due to a change in temperature. Thus, the [thermal radiation](#) of the surface is dramatically changed and can confuse an infrared camera."



Infrared images show conventional materials (top three rows) appear to an infrared camera as they heat up. Special coatings developed by UW–Madison engineers hide the temperature changes of the objects in the bottom two rows. Credit: Patrick Roney, Alireza Shahsafi And Mikhail Kats

In the lab, Shahsafi and fellow members of Kats' group demonstrated the

coating's efficacy. They suspended two samples—a coated piece of sapphire and a reference piece with no coating—from a heater so that part of each sample was touching the heater and the rest was suspended in much cooler air. When they viewed each sample with an infrared camera, they saw a distinct [temperature](#) gradient on the reference sapphire, from deep blue to pink, red, orange and almost white, while the coated sapphire's thermal image remained largely uniform.

A team effort was critical to the project's success. Purdue collaborator Shriram Ramanathan's group synthesized the samarium nickel oxide and performed detailed materials characterization. Colleagues at MIT and at Brookhaven National Laboratory used the bright light of a particle-accelerating synchrotron to study the [coating](#)'s atomic-level behavior.

**More information:** Alireza Shahsafi et al. Temperature-independent thermal radiation, *Proceedings of the National Academy of Sciences* (2019). [DOI: 10.1073/pnas.1911244116](https://doi.org/10.1073/pnas.1911244116)

Provided by University of Wisconsin-Madison

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