Smart glass blocks heat or light at flick of a switch

Spray-on coating is a step towards energy-efficient windows.

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14 August 2013

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A film sprayed onto glass (left) can block heat and visible light.

An engineered window coating can be tweaked to respond to changing weather conditions. Small voltages applied to the material trigger it to block heat and, independently, light.

Selective control over the amount of heat and light passing through windows could help to keep buildings cool during the summer and warm during the winter. Around 4% of all energy consumed in the United States is used to cool or warm buildings to compensate for heat transfer through windows, according to the US Department of Energy.

“The ability to perform well in hot and cold climates could mean big energy savings,” says Delia Milliron, a materials chemist at Lawrence Berkeley National Laboratory in Berkeley, California, who led the team that developed the material.

The recipe, reported in *Nature*[1], calls for nanoscale crystals of indium tin oxide, a conductive material used to coat flat-panel displays. When indium tin oxide is jolted with electricity, the extra electrons help it to absorb as much as 35% of heat-producing near-infrared radiation passed through the crystals.

The researchers embedded some of those nanoscale heat sponges into glass made from niobium oxide, which darkens when exposed to current. Together, the two materials allow control of both heat and visible light passing through the window. The composite remains essentially transparent to both forms of radiation until a voltage is applied, at which point the crystals switch on to soak up heat. Boost that voltage, and the crystals continue to block heat as the niobium oxide darkens, screening out light.

Strength in numbers

Each of the two ingredients is better at screening radiation as part of the team than on its own. When they are bonded, the composite material can stop a little more than 50% of heat and 70% of visible light. And it remains stable even after being switched on and off 2,000 times.

Milliron is developing the technology with a start-up company called Heliotrope in Oakland, California, which specializes in smart windows. Her coating can be sprayed onto the inside of a glass pane. But turning the coating off and on requires applying a voltage directly to its surface. In the lab, Milliron generated the needed voltage by incorporating the material into a battery. Out in the real world, thin, transparent films layered on top of the coating will be needed to supply that voltage.

Such modifications will make smart windows expensive, says Brian Korgel, a materials chemist at the University of Texas at Austin and the author of a News & Views article on the research. If the technology is to be adopted, “the overall cost of the system cannot be

prohibitively high", he warns.

Energy savings could help to offset the large price tag, but Milliron is also looking for ways to cut costs. One option may be to replace the expensive indium tin oxide with cheaper zinc-based crystals, which have already shown promise in the lab.

Nature | doi:10.1038/nature.2013.13558

References

1. Llordés, A., Garcia, G., Gazquez, J. & Milliron, D. J. *Nature* **500**, 323–326 (2013).