

Clever coating opens door to smart windows

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Mohammad Taha shows off the ultra-thin coating developed at RMIT University. Credit: RMIT University/James Giggacher

Researchers from RMIT University in Melbourne Australia have developed a new ultra-thin coating that responds to heat and cold, opening the door to "smart windows".

The self-modifying coating, which is a thousand times thinner than a human hair, works by automatically letting in more heat when it's cold and blocking the sun's rays when it's hot.

Smart windows have the ability to naturally regulate temperatures inside a [building](#), leading to major environmental benefits and significant financial savings.

Lead investigator Associate Professor Madhu Bhaskaran said the breakthrough will help meet future energy needs and create temperature-responsive buildings.

"We are making it possible to manufacture [smart windows](#) that block heat during summer and retain heat inside when the weather cools," Bhaskaran said.

"We lose most of our energy in buildings through windows. This makes maintaining buildings at a certain temperature a very wasteful and unavoidable process.

"Our [technology](#) will potentially cut the rising costs of air-conditioning and heating, as well as dramatically reduce the carbon footprint of buildings of all sizes.

"Solutions to our energy crisis do not come only from using renewables; smarter technology that eliminates energy waste is absolutely vital."

Smart glass windows are about 70 per cent more energy efficient during summer and 45 per cent more efficient in the winter compared to standard dual-pane glass.

New York's Empire State Building reported energy savings of US\$2.4 million and cut carbon emissions by 4,000 metric tonnes after installing

smart glass windows. This was using a less effective form of technology.

"The Empire State Building used glass that still required some energy to operate," Bhaskaran said. "Our coating doesn't require energy and responds directly to changes in temperature."

Co-researcher and PhD student Mohammad Taha said that while the coating reacts to temperature it can also be overridden with a simple switch.

"This switch is similar to a dimmer and can be used to control the level of transparency on the window and therefore the intensity of lighting in a room," Taha said. "This means users have total freedom to operate the smart windows on-demand."

Windows aren't the only clear winners when it comes to the new coating. The technology can also be used to control non-harmful radiation that can penetrate plastics and fabrics. This could be applied to medical imaging and security scans.

Bhaskaran said that the team was looking to roll the technology out as soon as possible.

"The materials and technology are readily scalable to large area surfaces, with the underlying technology filed as a patent in Australia and the US," she said.

The research has been carried out at RMIT University's state-of-the-art Micro Nano Research Facility with colleagues at the University of Adelaide and supported by the Australian Research Council.

Their findings have been published in *Scientific Reports* - Nature:
<http://dx.doi.org/doi:10.1038/s41598-017-17937-3>

How the coating works

The self-regulating coating is created using a material called vanadium dioxide. The coating is 50-150 nanometres in thickness.

At 67 degrees Celsius, vanadium dioxide transforms from being an insulator into a metal, allowing the coating to turn into a versatile optoelectronic material controlled by and sensitive to light.

The coating stays transparent and clear to the human eye but goes opaque to infra-red solar radiation, which humans cannot see and is what causes sun-induced heating.

Until now, it has been impossible to use [vanadium dioxide](#) on surfaces of various sizes because the placement of the coating requires the creation of specialised layers, or platforms.

The RMIT researchers have developed a way to create and deposit the ultra-thin [coating](#) without the need for these special platforms - meaning it can be directly applied to surfaces like glass windows.

More information: Mohammad Taha et al, Insulator–metal transition in substrate-independent VO₂ thin film for phase-change devices, *Scientific Reports* (2017). [DOI: 10.1038/s41598-017-17937-3](https://doi.org/10.1038/s41598-017-17937-3)

Provided by RMIT University

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