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Electrochromic window material blocks infrared radiation

10th November 2021 9:14 am

An electrochromic window material that controls heat transmission without blocking views has been developed by an international team led by scientists from Nanyang Technological University, Singapore.

'Smart' window coating invented by NTU Singapore s...



The new material, which could help cut the energy required to cool and heat buildings, has a specifically designed nanostructure and comprises materials including titanium dioxide (TiO_2), tungsten trioxide (WO_3), neodymium-Niobium (Nd-Nb), and tin (IV) oxide (SnO_2). The composite material is intended to be coated onto glass window panels, and when activated by electricity, users would be able to control infrared radiation transmission through the window.

The advance, detailed in *ACS Omega*, could block up to 70 per cent of infrared radiation according to experimental simulations without compromising views since it allows up to 90 per cent of visible light to pass through.

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Electrochromic windows work by becoming tinted when in use, reducing light from entering the room. Commercially available electrochromic windows commonly have a layer of tungsten trioxide (WO_3) coated on one side of the glass panel. When the window is switched on, an electric current moves lithium ions to the side containing WO_3 , and the window darkens or turns opaque. Once switched off, the ions migrate away from the coated glass, and the window becomes clear again.

However, current electrochromic windows are only effective in blocking visible light, so heat continues to pass through the window.

Another perceived drawback of the current technology is its durability, as the performance of the electrochromic component tends to degrade in three to five years. In lab tests, NTU's electrochromic technology was put through on-off cycles to evaluate its durability and results showed the properties of the window retained 'excellent stability', blocking over 65 per cent of infrared radiation.

Lead author, Associate Professor Alfred Tok of NTU's School of Materials Science and Engineering said: "By incorporating the specially designed nanostructure, we enabled the material to react in a 'selective' manner, blocking near infrared radiation while still allowing most of the visible light to pass through whenever our electrochromic window is switched on. The choice of advanced materials also helped improved the performance, stability and durability of the smart window."



(L-R front) The NTU School of Materials Science and Engineering team behind the new energy-saving material for electrochromic (EC) windows include Amanda Ong, Project Officer, Assoc Prof Alfred Tok, (L-R rear) Dr Ronn Goei, senior research fellow, and student Rayner Ng (Image: NTU Singapore)

The patented NTU switch is said to comprise of magnetic carbon-based particles and thin films that are good conductors of heat. When the switch is turned off, conducted heat cannot transfer through the window, but the heat can pass through when switched on.

When integrated with the newly developed electrochromic material, the team said in a statement that its smart window can control infrared radiation and conduction heat.

First author of the study, Dr Ronn Goei, senior research fellow at the NTU School of Materials Science and Engineering said: "With the ability to control both infrared radiated heat from the sun and conducted heat passing through the window, we expect this technology to be particularly useful in temperate climates, as building occupants can use it to regulate heat loss or gain according to the needs of the changing seasons, while still enjoying much of the view."