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NTU team develops energy saving glass

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An international research team led by Nanyang Technological University (NTU) Singapore has developed a 'self-adapting' energy saving glass material that can heat or cool rooms.

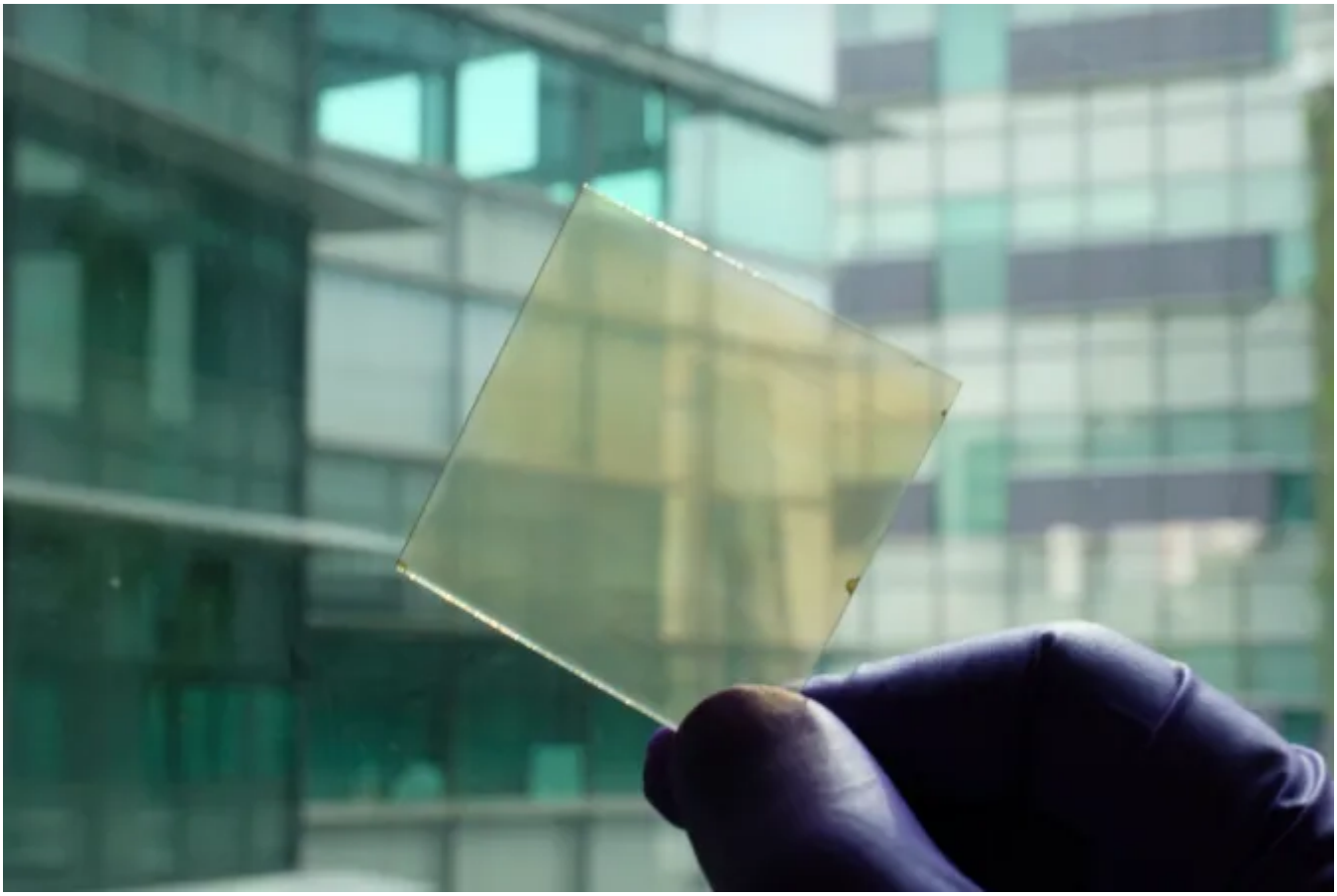

Image credit: NTU Singapore

Reported in the journal *Science*, the glass is said to automatically respond to changing temperatures by switching between heating or cooling. It was developed using layers of vanadium dioxide nanoparticles composite, Poly(methyl methacrylate) (PMMA) and low-emissivity coating to form its unique structure.

The energy saving glass, which has no electrical components, works by exploiting the spectrums of light responsible for heating and cooling.

During summer it suppresses solar heating (near infrared light) while boosting radiative cooling (long-wave infrared) – a natural phenomenon where heat emits through surfaces towards the cold universe – to cool the room. In winter, it does the opposite to warm the room.

According to the team, lab tests conducted using an infrared camera to visualise results showed that the glass allowed a controlled amount of heat in various conditions (room temperature – above 70°C) proving its ability to react dynamically to changing weather conditions.

An estimation based on data from the US Department of Energy suggests that in the States alone, window-associated energy consumption (heating and cooling) in buildings accounts for approximately four per cent of their total primary energy usage each year.

Scientists have developed sustainable innovations to ease this energy demand, such as using low-emissivity coatings to prevent heat transfer and electrochromic glass that regulates solar transmission from entering the room by becoming tinted.

However, none of the solutions have been able to modulate both heating and cooling at the same time until now – a 'crucial' function to improve window performance, said the study's co-authors at the University of Wyoming, USA and University of Science and Technology, Wuhan, China.

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Principal investigator Dr Long Yi, NTU School of Materials Science and Engineering, said: "Most energy-saving windows today tackle the part of solar heat gain caused by visible and near infrared sunlight. However, researchers often overlook the radiative cooling in the long wavelength infrared.

"While innovations focusing on radiative cooling have been used on walls and roofs, this function becomes undesirable during winter. Our team has demonstrated for the first time a glass that can respond favourably to both wavelengths, meaning that it can continuously self-tune to react to a changing temperature across all seasons."

The NTU team believes its innovation offers a convenient way to conserve energy in buildings since it doesn't rely on moving components, electrical mechanisms or blocking views to function.

As a proof of concept, the scientists tested the energy-saving performance of their invention using simulations of climate data covering all populated parts of the globe (seven climate zones).

Their results showed the glass achieved energy savings in both warm and cool seasons, with an overall energy saving performance of up to 9.5 per cent, or ~330,000kWh per year less than commercially available low-emissivity glass in a simulated medium sized office building.

The heating and cooling performance can also be customised to suit the needs of the market and intended region, explained Dr Long Yi, by adjusting the structure and composite of the nanocomposite coating layered onto the glass panel.

A Singapore patent has been filed for the innovation, and next steps include aiming for even higher energy-saving performance by working on the nanocomposite coating's design.