Goodbye Curtains! IIT Indore Develops Smart Glass That Thinks of Your Windows

Researchers at IIT Indore are developing a new kind of smart glass that could change the way we use windows in our homes and offices. Under the guidance of **Prof. Suman Mukhopadhyay** from the Department of Chemistry and **Prof. Rajesh Kumar** from the Department of Physics, this innovative work is being carried out under the **Translational Research Fellowship** (TRF) scheme by researcher Dr. Sayantan Sarkar from the Department of Chemistry.

The project focuses on creating electronic curtain glass that can control how much light and heat passes through it by simply applying a small electric current. The key material behind this technology is a newly developed viologen-based porous organic polymer, also known as POP. These POPs are specially designed to be low-cost, long-lasting, and easy to produce in large quantities. What makes them special is their quick response to electricity, they can change color and transparency, which allows them to block sunlight and heat when needed, or let it in when it's cooler outside. This smart adjustment helps save energy by reducing the need for air conditioning or artificial lighting.

The researchers have already tested these materials successfully in the lab, and their initial results have been published in the journal ACS Applied Materials and Interfaces. To make the smart glass, the POP coating is applied onto glass surfaces using methods like spray-coating and dip-coating. These methods make sure the coating is smooth, sticks well to the glass, and works reliably over time. The coated layer is then placed between two transparent electrodes thin, nearly invisible metal layers that respond to electric signals. Right now, the team is testing small glass samples to see how fast they change color, how clear they look, and how well they perform under sunlight, heat, and other everyday conditions.

What sets this project apart is that the team is not only focused on lab success but also on how to bring this smart glass into real-life use. They are working closely with industry partners to make sure the glass can be produced using current factory setups. This means it could be easily added to existing product lines without needing big changes. Unlike regular curtains or window films, this smart glass adjusts on its own to the environment, offering comfort, privacy, and energy savings in a modern and elegant way.

Speaking about the institute's commitment to innovation, **Prof. Suhas S. Joshi, Director, IIT Indore**, said, "At IIT Indore, we are dedicated to transforming academic research into technologies that benefit society. The smart glass project is a fine example of **interdisciplinary collaboration** aimed at achieving sustainability and national progress."

Prof. Mukhopadhyay shared, “This technology is a perfect example of how fundamental chemistry can lead to smart and scalable engineering solutions. The use of viologen-based polymers allows for quick and reliable color change, which can significantly impact how we design energy-efficient buildings.”

Prof. Rajesh Kumar added, “By integrating material science and applied physics, we’ve created a responsive glass solution that not only works in the lab but is also fit for industrial use. This has the potential to replace traditional window systems in the near future.”

In the future, these **smart electrochromic windows** could become common in **smart homes and eco-friendly buildings**, helping to lower electricity bills and reduce the impact on the environment. As India moves forward with its goals for green energy and smart infrastructure, innovations like this from IIT Indore show how academic research can lead to real-world solutions. This smart glass project is not just a technical achievement but also a step towards addressing both national needs and global challenges.