Advancements in Smart Windows

Why in News?

Researchers at the **Centre for Nano and Soft Matter Science in Bengaluru** have introduced a new dimension to smart window technology by combining **hierarchical double network polymers with liquid crystals.**

What is a Hierarchical Double Network of Polymers?

- **Hierarchical** Double Networks of Polymers are a type of **interpenetrating polymer networks (IPNs).**
    - IPNs are **soft matter systems** that combine different polymer networks to optimize various properties.
    - IPNs have potential applications in fields like smart windows, and sensors.
- Hierarchical Double Networks combine **rigid and soft networks** to achieve desired **thermal, electrical, and optical properties.**
- They can be tailored to specific requirements, such as **mechanical, optical, and electrical properties.**

- **Polymer:**
    - Polymers are **large molecules composed of smaller molecules called monomers**, which are linked together in a **chain-like structure.**
    - Examples of polymers include common materials like **plastic and rubber.**

What are the Advancements in Smart Windows?

- **Enhanced Control with Double Networks:**
    - These double networks **combine different materials and allow for precise manipulation of their properties.**
    - Integration of multiple functionalities into a single window system.
- **Combining Light and Temperature:**
    - The research team has utilized both light and temperature control to create double networks. Light is used to form a self-assembled polymer network, while temperature triggers the formation of a second network that traps the first one. This unique combination of stimuli provides advanced control over the window's properties.
- **Trapping Liquid Crystals:**
    - The double network structure effectively traps liquid crystals, which are responsible for regulating light transmission. This enables the smart windows to **switch between transparency and opacity, providing privacy and energy-saving features.**
- **Benefits:**
    - **Energy Efficiency:** They consume very little energy, making them environmentally friendly and cost-effective.

- **Privacy Control:** The windows can change from transparent to opaque, giving users control over their privacy.
    - Smart windows capable of switching between high and low haze states.
- **High Resolution:** The use of modern techniques allows for precise control over the level of opacity, providing excellent resolution.

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