'Smart windows' have potential to keep heat out and save energy

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Windows allow brilliant natural light to stream into homes and buildings. Along with light comes heat that, in warm weather, we often counter with energy-consuming air conditioning. Now scientists are developing a new kind of "smart window" that can block out heat when the outside temperatures rise. The advance, reported in ACS' journal *Industrial & Engineering Chemistry Research*, could one day help consumers better conserve energy on hot days and reduce electric bills.

Xuhong Guo, Kaimin Chen, Yanfeng Gao and colleagues explain that researchers are pursuing smart windows that can respond to a variety of cues, including electricity, gas, light and heat. Those that are sensitive to heat are particularly useful for cutting down on energy use—when it gets hot outside, the windows turn an opaque white to block unwanted heat from entering a building while still allowing light to pass. They become transparent again as temperatures drop. But current methods for making these windows use jelly-like materials called hydrogels that swell in the heat, which hurts performance. Guo's and Gao's teams wanted to address this flaw.

Building on previous advances, the researchers made a version of the hydrogels, but in the form of microscopic soft beads suspended in a liquid. They sandwiched the solution between two pieces of glass and tested it using a model house. When they shined a lamp mimicking solar light on the smart window, it turned opaque and kept the inside of the house cool. The microgel, however, didn't swell as much as its predecessor. The researchers conclude that their new microgel is a good candidate for use in future smart windows.

More information: "Binary Solvent Colloids of Thermosensitive Poly(N-isopropylacrylamide) Microgel for Smart Windows" *Ind. Eng. Chem. Res.*, 2014, 53 (48), pp 18462–18472. DOI: 10.1021/ie502828b

Abstract

Thermosensitive poly(N-isopropylacrylamide) (PNIPAAm) microgel colloids were prepared by using water and high-boiling alcohol as binary solvent. Their thermosensitive behavior and solar modulation ability were studied by differential scanning calorimetery, ultraviolet–visible–near-infrared spectrophotometery, dynamic light scattering, and rheology. Effects of alcohol content and cross-linker dose on their microstructures and optical properties were investigated. A model house was constructed to test their energy-saving performance in smart windows. It was found that the solar modulation ability of PNIPAAm microgel colloids decreased with increasing N,N′-methylenebis(acrylamide) (BIS) dose or alcohol content. Compared to glycol, glycerol showed better compatibility with PNIPAAm hydrogels, inducing less deterioration of the solar modulation ability. With 0.1 wt % (of NIPA) BIS, when glycerol was added as a cosolvent, the prepared PNIPAAm microgel colloids exhibited spherical morphology, controllable LCST, short response time, suitable viscosity, low freezing point, restrained evaporation rate, and excellent energy-saving performance, which makes them much better candidates for application in smart windows than those using a single solvent.

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