Switchable mirror glass produced for energy efficient windows

30 January 2007

Switchable mirror that turns into a color-neutral transparent state. Credit: AIST

Although windows can naturally heat buildings in the cold seasons, some hot sunny days might make you wish that windows would just go away. Scientists from Japan have recently designed new technology that will make windows seem to disappear by turning clear, transparent glass into mirrors.

The group, from the National Institute of Advanced Industrial Science and Technology (AIST), has designed and produced the first full-size sample of switchable mirror glass to be realistically compatible in buildings, houses and cars.

A switchable glass is glass with adjustable transparency or color, or in this case, reflective properties. Scientists Kazuki Yoshimura and Shanhu Bao experimented with improving the characteristics of previous switchable glass by using magnesium-titanium alloy as the switchable film. Two glass sheets of 60 x 70 cm (24 x 28 in) made up the window structure, and each had an interior coating of 40-nm-thick magnesium-titanium alloy, plus a 4-nm-thick layer of palladium.

According to Yoshimura and Bao, finding the correct alloy mixture was essential to producing a transparent and energy efficient switchable glass. Previous attempts at switchable glass faced commercialization problems such as being too expensive (e.g. yttrium and lanthanum), or having a yellowish tint that was unsuitable for cars or clear viewing (e.g. magnesium-nickel).

While other types of switchable glasses have already been commercialized, these varieties tend to have minimal advantages in energy efficiency. For example, electrochromatic glass, which works by using electrical signals to change color and absorb sunlight, reaches high temperatures that often end up re-radiating infrared radiation in the room.

The switching mechanism in Yoshimura and Bao's window, on the other hand, is done by altering the gas content between the two glass panes. By introducing a small amount of hydrogen into the atmosphere between the panes, the glass acts as a transparent window. Alternatively, adding a small amount of oxygen with no hydrogen forms a reflecting mirror.

"Small amounts of hydrogen and oxygen for use in the switching process can be readily generated by decomposition of water," the scientists reported. "The thin film showed excellent switching characteristics. . . . The change between states is very impressive."

By applying this switchable glass to windows in homes, offices and cars, the scientists estimate that reduced air conditioning needs could result in an energy savings of up to 30%. Scientists at the AIST are currently working on maximizing the durability of the switchable glass, and overcoming the deterioration that arises due to repeated switching.

Also, because the magnesium-titanium alloy can be applied to transparent materials besides glass, more applications may yet be discovered.