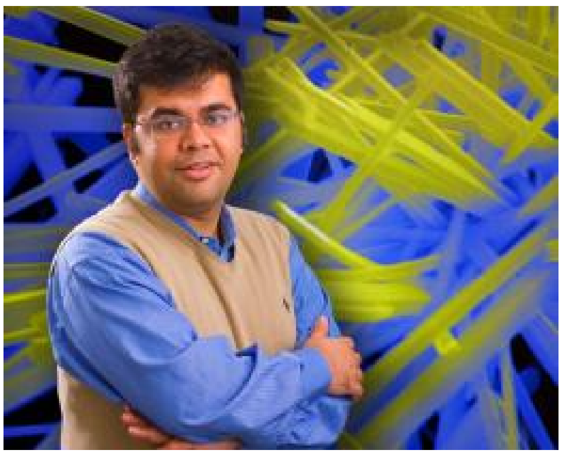
Windows that block heat only on hot days: New research brings us closer

April 8 2011



UB's Sarbajit Banerjee with a scanning electron microscopy image of tungsten-doped vanadium-oxide nanowires, which have a phase transition temperature close to room temperature.

(PhysOrg.com) -- New materials science research from the University at Buffalo could hasten the creation of "smart" windows that reflect heat from the sun on hot summer days but let in the heat in colder weather.

The findings concern a unique class of synthetic chemical compounds that are transparent to infrared light at lower temperatures, but undergo a phase transition to begin reflecting infrared when they heat up past a certain point.

An article detailing some of these discoveries appears today (April 7) on the cover of the *Journal of Physical Chemistry Letters*. Additional papers have appeared online or in print in *CrystEngComm*, the *Journal of Materials Chemistry* and *Physical Review B*.

In the papers, UB researchers report that they have managed to manipulate the trigger temperature for vanadium oxide, one such material. The advance is a crucial step toward making the compound useful for applications such as coatings for energy-saving windows.

By preparing vanadium oxide as a nanomaterial instead of in bulk, the scientists managed to lower the compound's trigger point from 153 degrees Fahrenheit to 90. Doping vanadium oxide nanowires with tungsten brought the temperature down further, to 7 degrees Fahrenheit. Molybdenum doping had a similar but smaller effect.

Researchers also found that they were able to induce a phase transition using an electric current instead of heat.

UB chemist Sarbajit Banerjee led the studies, collaborating with Sambandamurthy Ganapathy, an assistant professor of physics, to head the Physical Review B research on the use of the electric current.

"Definitely, we are closer than we've ever been to being able to incorporate these materials into window coatings and other systems that sense infrared light," said Banerjee, an assistant professor. "What we found is an example of how much of a difference finite size can make. You have a material like vanadium oxide, where the phase transition temperature is too high for it to be useful, and you produce it as a nanomaterial and you can then use it right away."

Banerjee and Ganapathy previously led research projects demonstrating that, in nanoscale form, two additional synthetic compounds -- copper vanadate and potassium vanadate -- exhibit phase transitions akin to those in vanadium oxide.

Banerjee's work has caught the attention of the National Renewable Energy Laboratory, which has contacted him to discuss developing window coatings that could improve the energy efficiency of buildings with heating or air conditioning systems. The technology could be particularly useful in places like Phoenix and Las Vegas that experience extreme summer temperatures.

Besides smart windows, vanadium oxide could also be useful in products including computer chips, night-vision instruments and missile guidance systems, Banerjee said.

Two major awards are funding Banerjee's research on the material: A Cottrell Scholar Award from the Research Corporation for Science Advancement, announced this year, and a National Science Foundation CAREER award, the foundation's most prestigious award for junior investigators.

More information: pubs.acs.org/doi/abs/10.1021/jz101640n
The research is described in a video at pubs.acs.org/page/jpclcd/banerjee-video.html

Provided by University at Buffalo