Will carbon nanotubes replace indium tin oxide?

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(PhysOrg.com) -- Up until now, George Grüner tells *PhysOrg.com*, most of the studies regarding the properties - and uses - of carbon nanotubes have been restricted to the visible spectral range. “We, however, were interested in the properties in infrared range, in the window of the electromagnetic spectrum that is gaining increased prominence.”

Grüner, a professor at the University of California, Los Angeles, worked with Liangbing Hu and David S. Hecht to explore the infrared properties of thin films made with carbon nanotubes. Their work demonstrated that carbon nanotubes are highly transparent in the infrared range. “This attribute would make such films ideal replacement for indium tin oxide,” Grüner says. Their work can be found in Applied Physics Letters: “Infrared transparent carbon nanotube thin films.”

“Finding transparent metals, which are ideal materials for use in such technologies as touch screens and solar cells, is not easy thing to do. Indium tin oxide, ITO, is predominantly used,” Grüner explains. However, ITO is rather brittle and the indium used in the alloy is becoming scarce. Scientists have discovered that films of carbon nanontubes are conductive and sufficiently transparent in the visible range, offering the potential to replace indium tin oxide.

While finding a replacement for indium tin oxide for applications that make use of visible light is significant, Grüner and his colleagues were more interested in whether or not carbon nanotube thin films could be useful in the infrared range as well. “ITO is not much transparent in the

infrared range," Grüner says, "so there are some applications that wouldn't be suited for."

"A range of applications are making use of the infrared range," Grüner continues. "Military applications would benefit greatly, especially in terms of infrared sensors, cameras and projectors." Additionally, making effective use of the infrared range could also lead to more efficient solar cells. "A significant fraction of the radiation from the sun is in the infrared range. As mentioned, ITO, used as electrodes in solar cells is not transparent at infrared, this leads to decreased efficiency. Carbon nanotube thin films are transparent in the infrared range, this could help developing more efficient solar energy."

In order to test the abilities of the carbon nanotubes, Grüner and his students set up an experiment to direct infrared light through the thin film they had prepared. By measuring the intensity on the other side of the film, they were able to gauge its transparency. "It's really pretty straightforward," Grüner says. "The art is really making a well conducting film."

Grüner points out that such films are more transparent than other materials showing good optical transparency is the visible spectral range. "That came as a bit of a surprise," he acknowledges. "This opens up a number of interesting opportunities for a variety of applications," Grüner says. "We are looking forward to seeing if what we have found will finds it's way into useful applications."

More information: Hu, Hecht and Grüner. "Infrared transparent carbon nanotube thin films," Applied Physics Letters (2009). Available online: link.aip.org/link/?APPLAB/94/081103/1.

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