Docket #: S12-107

Strong and stable doping of carbon nanotubes and graphene by MoOx for transparent electrodes

Stanford researchers have developed and tested a new method of stably and strongly doping CNTs and graphene using MoOx as a nontoxic, inexpensive, vacuum or solution deposited alternative to strong liquid acids. Carbon nanotube (CNT) networks and graphene thin films have recently been studied intensively for transparent electrodes which are crucial for touch screen, flat panel display and solar cell technologies. Excellent thermal and chemical stability coupled with high conductivity makes MoOx-CNT composites extremely attractive candidates for practical transparent electrodes.

Figure

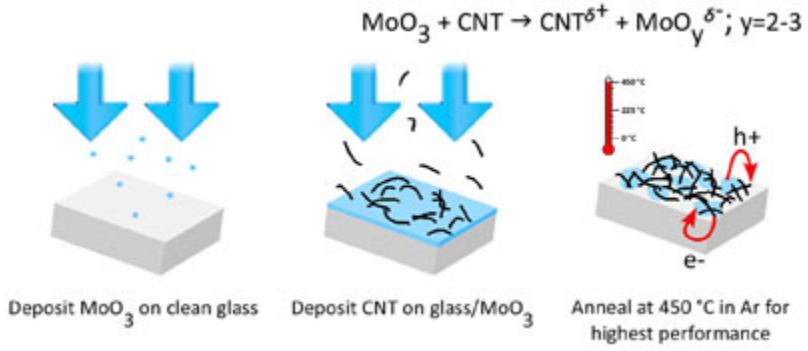

Figure description - Schematic showing the fabrication of MoOx-CNT transparent conductors.

Stage of Research

- Reduced to practice - Tests show that MoOx can strongly and stably dope carbon nanotubes and graphene.
- Thermally annealed MoOx-CNT composites can form durable thin film electrodes with sheet resistances of 100 ?/sq at 85% transmittance plain and 85 ?/sq at 83%

transmittance with a PEDOT:PSS adlayer. Sheet resistances change less than 10% over 20 days in ambient and less than 2% with overnight heating to 300 °C in air. The MoOx can be easily deposited either by thermal evaporation or from solution-based precursors.

Applications

- **Transparent electrodes** for:
  - thin film solar cells
  - flat panel displays
  - touch screens

Advantages

- Thermal and chemical stability coupled with high conductivity
- Can be deposited by either thermal evaporation or from solution-based precursors;
- Flexible and stretchable
- Solution processability
- Mild, stable, reliable, low toxicity doping method

Publications

- U.S. Patent Application No. 13/911,848
- Sondra L. Hellstrom, Michael Vosgueritchian, Randall M. Stoltenberg, Irfan Irfan, Mallory Hammock, Yinchao Bril Wang, Chuancheng Jia, Xuefeng Guo, Yongli Gao‡, and Zhenan Bao, Strong and Stable Doping of Carbon Nanotubes and Graphene by MoOx for Transparent Electrodes, Nano Lett. 2012 12(7), pp.3574-3580, published online June 13, 2012. DOI: 10.1021/nl301207e

Patents

- Published Application: 20130330559

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