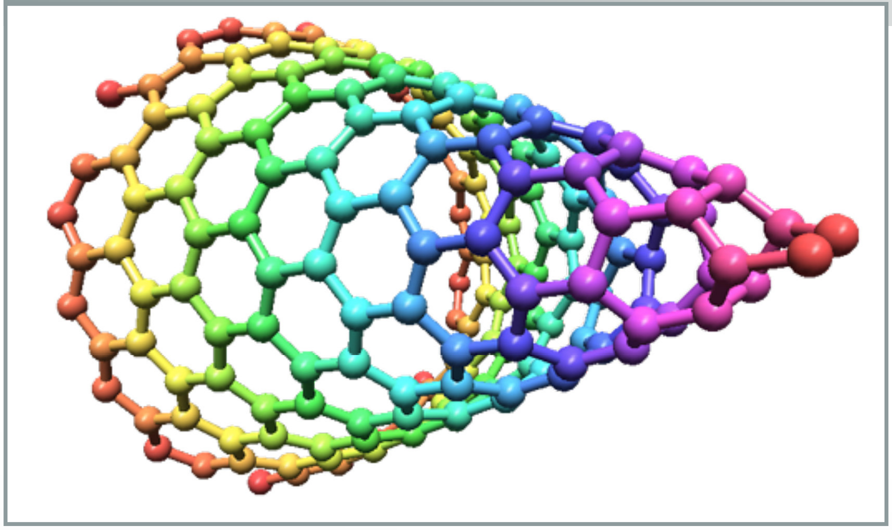
Material-Independent Design of Photoluminescent Systems

UT-B ID 200802034



Technology Summary

Nanomaterials have attracted much attention recently because of their unique functionality. Researchers at ORNL have discovered a method to make nonluminescent nanostructured materials luminescent (photoluminescent and/or electroluminescent), independent of the starting material. This material-independent approach enables conversion of many different types of nanomaterials for optoelectronic applications such as light-emitting displays, solar panels, optoelectronic sensing and imaging spectroscopy, and fiber-optic communications. It will also enhance their use in many in vivo applications such as the study of intracellular processes; high resolution cellular imaging; long-term observation of cell trafficking; cancer diagnostics; and tumor targeting, where many of the competing methods are cytotoxic.

The ORNL technique involves (1) providing a nanostructured material; (2) modifying the surface of the material to create isolated regions that will act as luminescent centers, in the process generating a charge imbalance on the surface of the nanostructured material; (3) applying one or more polar molecules to the charged surface of the nanostructured material; and (4) orienting the polar molecules to compensate for or neutralize the surface charge imbalance. Once the surface charge imbalance has been neutralized, the isolated regions can exhibit luminescent behavior.

The nanostructured material itself can be any of a variety of materials, such as boron nitride, amorphous carbon, or silicon carbide, and could be in the form of single-walled nanotubes, multiwalled nanotubes, nanohorns, nano-onions, etc. The formation of the isolated regions and the charge imbalance on the surface of the nanostructured material may be accomplished by acid etching or functionalizing the surface of the nanostructured material with charged groups such as carboxylic acid (–COOH) moieties or hydroxyl (-OH) moieties. The polar molecules may be applied to the charged surface by a number of methods, including immersing the nanostructured material in a liquid solution containing the polar molecules or applying the polar molecules as part of a coating to the surface of the nanomaterial.

Advantages

- Materials independent
- Flexible processes
- Cost-effective to manufacture

Potential Applications

- Electroluminescent systems for use in light-emitting displays, solar panels, or optoelectronic sensing elements
- Single-electron transistors, diode lasers, and electronic/optical amplifiers
- Inert biological markers/sensors
- High resolution cellular imaging
- Long-term in vivo observation of living organisms at the cellular level
- Tumor detection
- Therapeutic drug delivery, including tumor targeting
- Security ink; signage (e.g., exit signs, safety signs)
- Industrial/factory process monitoring
- Replacement for organic dyes in diagnostic systems (20 × brighter and 100 × more stable than traditional fluorescent reporters)

Patents

Ilia N. Ivanov, Alexander A. Puretzky, Bin Zhao, David B. Geohegan, David J. Styers-Barnett, and Hui Hu. *Luminescent Systems Based onthe Isolation of Conjugated PL Systems and Edge Charge Compensation with Polar Molecules on a Charged Nanostructured Surface,* U.S. Patent Application 12/895,226, filed September 30, 2010.

Inventor Point of Contact

Ilia N. Ivanov
Center for Nanophase Materials Sciences Division
Oak Ridge National Laboratory

Licensing Contact

David L. Sims
Technology Commercialization Manager
Building, Computational, Nanophase Materials, and Transportation Sciences
UT-Battelle, LLC
Oak Ridge National Laboratory
Office Phone: 865.241.3808
E-mail: simsdl@ornl.gov