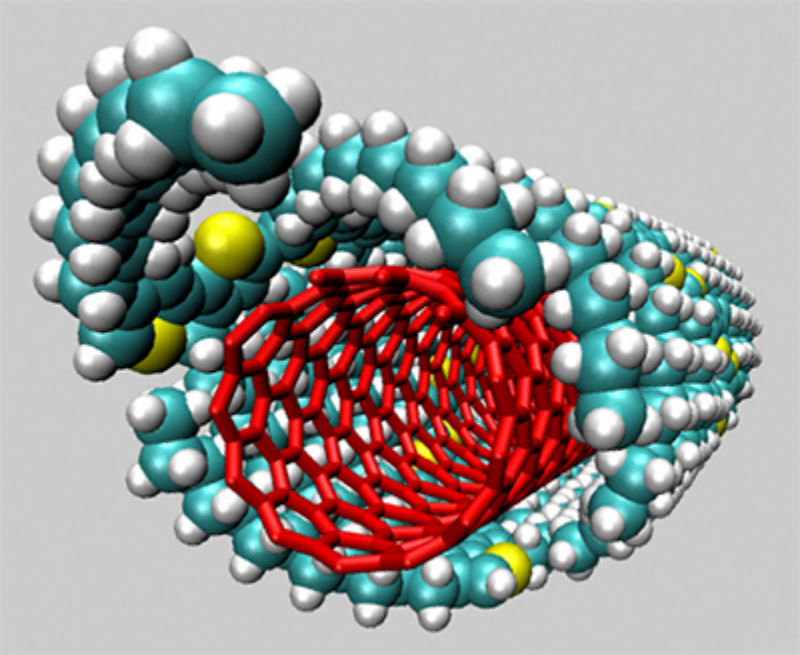
Docket #: S10-392

Sorting Semiconducting Carbon Nanotubes for Electronic Devices

Stanford researchers have developed a simple and effective method to sort semiconducting from metallic single walled carbon nanotubes (SWNT). This scalable technique uses semiconducting polymers to wrap around individual semiconducting SWNTs dispersed in a solution. This solution can be deposited as a transistor film after a centrifugation step.



Schematic of the polymer (blue) wrapped around the semiconducting single walled carbon nanotube (red)

Stage of Research

The inventors fabricated a thin film transistor using the dispersed SWNT semiconductor and demonstrated high semiconducting SWNT purity (>99%), excellent charge-carrier mobility (-12cm^2 $V^{?1}$ $s^{?1}$) and on/off ratio of > 10^6 without any post treatment 'burn-off.' This simple and effective method could addresses key manufacturing challenges to enable widespread adoption of carbon nanotubes in

electronics.

Related Technologies

Stanford Docket S15-023: **Sorting Semiconducting Single-Walled Carbon Nanotubes via Removable and Reusable Polymer**
Stanford researchers successfully purified highly enriched semiconducting single-walled carbon nanotubes (SWNTs) free of any dispersing agent via an easy, fast and scalable method using a recyclable supramolecular polymer.

Applications

- **Carbon nanotube purification** with end user applications in:
  - Solar cells, thin-film transistors, photovoltaic devices, organic light-emitting diodes, biosensors, sensor arrays, and electronic devices on flexible substrates
  - Semiconducting inks

Advantages

- **Simple and Effective** – carbon nanotubes are applied to a device without removal of the dispersant
- **Scalable** for industrial manufacturing of single walled carbon nanotubes

Publications

- Hang Woo Lee, Yeohoon Yoon, Steve Park, Joon Hak Oh, Sanghyun Hong, Luckshitha S. Liyanage, Huiliang Wang, Satoshi Morishita, Nishant Patil, Young Jun Park, Jong Jin Park, Andrew Spakowitz, Giulia Galli, Francois Gygi, Philip H.-S. Wong, Jeffrey B.-H. Tok, Jong Min Kim, & Zhenan Bao, Selective dispersion of high purity semiconducting single-walled carbon nanotubes with regioregular poly(3-alkylthiophene)s, *Nature Communications* 2, Article Number 541, published online 15 November 2011, DOI: 10.1038/ncomms1545.
- Sorting out the nanotubes, for better electronics, Stanford Report, published online, 16 November 2011.

- Park, Young-Jun, Jong-min Kim, Hang-woo Lee, and Zhenan Bao. "Method of Selective Separation Of Semiconducting Carbon Nanotubes, Dispersion Of Semiconducting Carbon Nanotubes, And Electronic Device Including Carbon Nanotubes Separated By Using The Method." U.S. Patent Application 13/282,783, filed October 27, 2011.

Patents

- Published Application: 20120104328
- Published Application: 20170033292
- Issued: 9,502,152 (USA)
- Issued: 10,355,216 (USA)

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