Method for producing single-walled carbon nanotubes with controlled length, diameter, and orientation

*Technology #m04-049*

Single-walled carbon nanotubes (SWNTs) are important components in nanotechnology, biotechnology, and nanoscale devices. However, current methods of production do not allow for control over SWNT orientation, distribution, size, helicity, and organization, which limits the potential of this material in research and application. Furthermore, these methods to produce SWNTs require fast-heating or an external electric field. This technology eliminates the need for these steps, forms SWNTs at ambient pressure, and increases control over SWNT length, diameter, and orientation.

**Mesoporous silica substrate doped with cobalt and molybdenum produces SWNTs with increased control and performance at ambient pressures**

This technology uses a modified chemical vapor deposition (CVD) method to form individual SWNTs. This method eliminates the need for a vacuum and carbon delivery at low pressures. Instead, the carbon feedstock, ethanol, is delivered by bubbling argon gas through an ethanol pool. The substrate is a mesoporous silica doped with cobalt and molybdenum to catalyze SWNT formation. The substrate surface properties and highly ordered nanostructure provide control over the size of the catalyst nanoparticles as well as the diameter and orientation of SWNTs formed on the surface. Argon gas flow can also be modulated to control SWNT orientation. Modification of the mesoporous template surface-structure and/or gas flow can be used to engineer SWNT materials with unique and highly controlled orientation and dimensions.

This process has been used to form SWNTs 4-5 millimeters in length, characterized with scanning electron microscopy.

**Lead Inventor:**

Stephen O’Brien, Ph.D.

**Applications:**

- Nanoscale transistors, integrated circuits and semiconductor chips
- Probes for scanning tunnel and atomic force microscopes
• Solar cells and batteries
• Molecular electronics
• Structural scaffold for biomaterials
• Light-weight textiles with improved strength and stiffness
• Hydrogen storage for hydrogen powered cars and vehicles
• Cancer cell ablation therapies

Advantages:

• Can form SWNTs at ambient pressure
• Improves linear flow inside reactor by using small components
• Forms ultra-long SWNTs on a millimeter range of length
• Increased control over SWNT diameter, organization, and orientation

Patent information:

Patent Pending (US \texttt{2008069760A1})

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Related Publications:


Inventors

Stephen Paul O'Brien