

Non-Confidential Description - PSU No. 4011
“Carbon Nanostructure Membranes”

Keywords:

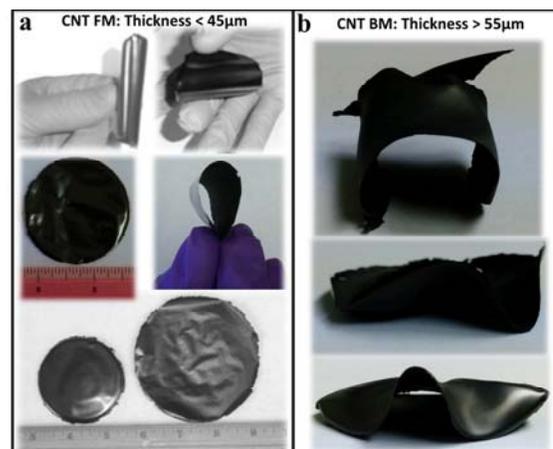
Carbon nanotubes, bucky paper, post-synthesis self-assembly, binder-free, membrane, flexible, processing carbon nanotube, powder

Links:

Provisional Patent Filed

Inventors:

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Carbon nanotube membranes

Background

Carbon nanotubes (CNTs) have been proposed and demonstrated as promising candidate for numerous applications in the emerging nanotechnologies due to their high mechanical strength, electrical conductivity, surface area, and chemical functionalizability. Most of these applications require macroscopic structures. Several post-synthesis methods including mechanical compaction, filtration, liquid-induced collapse and super acids have been used in transforming the CNTs into bucky paper, mats, yarns and membranes. However, in most cases, the properties of the macrostructured materials are abysmal compared to that of the individual CNTs. They turn out to be flaky, fragile and brittle with low packing density, and swelling has become a major problem in most of these CNT-based electrodes. Where a binder is used, it causes an increase in mass and a decrease in accessible active surface area, deteriorating the performance of the device.

Invention Description

This invention provides a way to processes CNT powder into flexible, robust, and binder-free macro-size membranes using a liquid-phase post-synthesis self-assembly (LP-PSSA) technique. A high-density liquid is used to spontaneously suspend the CNT powder and induce self-assembly, while the removal of the liquid via cryogenic trapping leads to the formation of the membrane. This process overcomes three critical challenges that none of the existing liquid-phase assembly of CNTs have been able to achieve: (1) it does not functionalize or damage the CNT skeletal structure, (2) it has limited or no degrading effects on the properties of the CNTs, and (3) the membranes have very high packing density with bulk density nearing that of individual CNTs.

Advantages/Applications

- Highly Flexible.
- High packing density
- Surface area >750m²/g
- Bulk mass density > water.
- Easy to handle.
- Binder-free.
- Electrode applications in supercapacitors, ultra-batteries and fuel cells
- Scaffold for other novel materials for applications in catalysis, thermoelectric, photovoltaic, electrolysis...

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