National Aeronautics and Space Administration

Carbon Nanotube Purification

Scientists at NASA Ames Research Center have developed an improved method of removing the residues of fabrication from carbon nanotubes has been invented. These residues comprise of amorphous carbon and metal particles that are produced during the growth process. Prior methods of removing the residues include a variety of processes that involved the use of halogens, oxygen, or air in both thermal and plasma processes. Each of the prior methods entails one or more disadvantages, including non-selectivity (removal or damage of nanotubes in addition to removal of the residues), the need to dispose of toxic wastes, and/or processing times as long as 24 hours or more. In contrast, the process described here does not include the use of toxic chemicals, the generation of toxic wastes, causes little or no damage to the carbon nanotubes, and involves processing times of less than one hour.

This technology is available for licensing from NASA's space program to benefit U.S. industry.

Patent

This technology has been patented.
U.S. Patent 6,972,056
(Reference No. ARC-14733-1)

Benefits

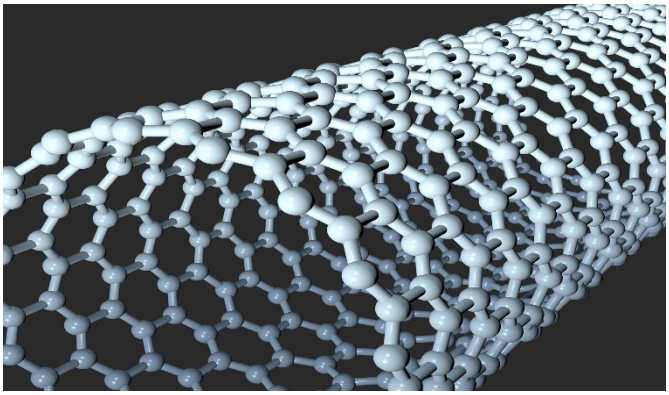
- Allows clean up of unwanted material, such as amorphous carbon
- Does not damage nanotubes
- Does not use harsh or toxic chemicals
- Approach requires less time to complete compared to other cleaning methods

Technology Details

What is needed is an in situ approach that allows clean-up of unwanted material, such as amorphous carbon, after an array of carbon nanotubes has been grown, that does not damage the nanotubes and that does not use harsh or toxic chemicals. Preferably, the unwanted material should be substantially separated and isolated from the nanotube array after the clean-up. Ideally, the approach should not require more than one hour to complete and should not require use and/or disposal of any hazardous substances. In the improved method, purification is accomplished by flowing water vapor through the reaction chamber at elevated temperatures and ambient pressures. The impurities are converted to gaseous waste products by the selective hydrogenation and hydroxylation by the water in a reaction chamber. This process could be performed either immediately after growth or in a post-growth purification process. The water used needs to be substantially free of oxygen and can be obtained by a repeated freeze-pump-thaw process. The presence of oxygen will non-selectively attach the carbon nanotubes in addition to the amorphous carbon.

Commercial Applications

- Energy storage for hydrogen, lithium intercalation, and electrochemical supercapacitors
- Molecular electronics including field emitting devices and transistors
- Nanoprobes and sensors
- Composite materials



Contact the Ames Technology Partnerships Office at 1-855-627-2249 or ARC-TechTransfer@mail.nasa.gov