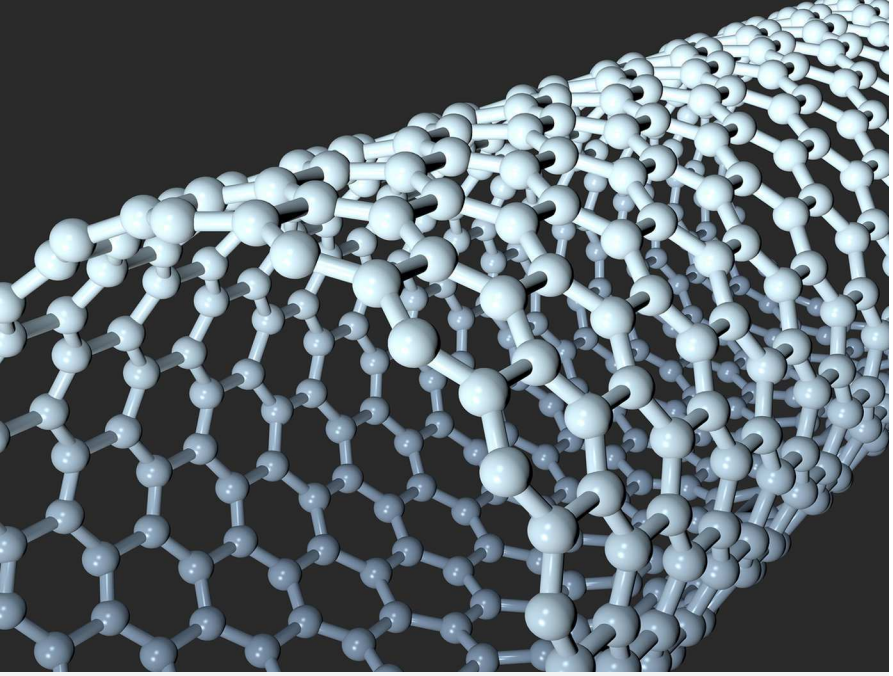


National Aeronautics and Space Administration

Manufacturing

Increased Alignment in Carbon Nanotube Growth (CNT)

Fabricating an array of two or more CNT structures on a coated substrate surface

Carbon Nanotubes (CNTs), due to their unique electronic and extraordinary mechanical properties, have been receiving much attention for a wide variety of applications. The combination of electronic and mechanical properties of CNTs has led to wide-ranging investigations of their potential in future electronics and computing ,field emitter devices ,sensors,electrodes,high-strength composites, and storage of hydrogen, lithium, and other metals. NASA has developed a method and system for fabricating an array of two or more CNT structures on a coated substrate surface. A single electrode is coated for a selected voltage application and time interval. The CNTs structures are then grown on a coated substrate surface with the desired orientation. Optionally, the electrode can be disconnected before the CNT structures are grown. Previous methods are not straight forward to control the growth and alignment of single wall carbon nanotubes (SWCNTs), multi-wall carbon nanotubes (MWCNTs) and/or carbon nanofiber (CNF).

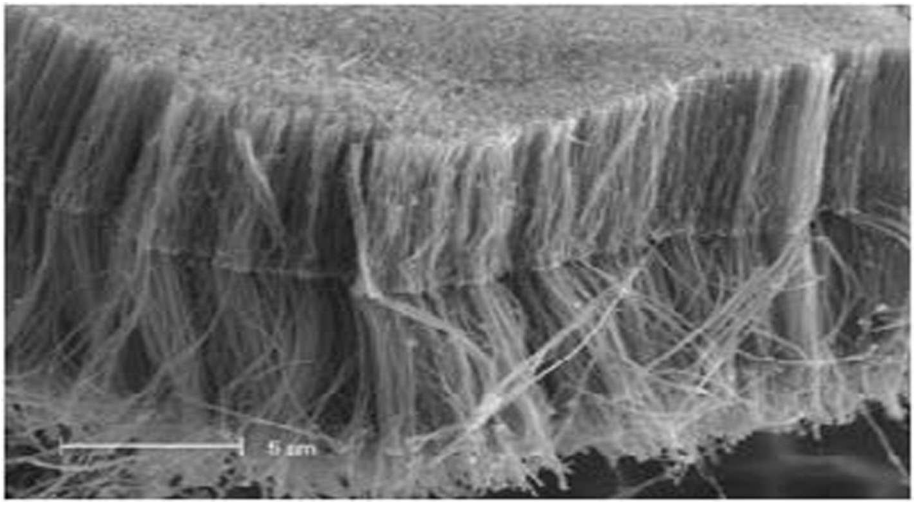
BENEFITS

- High strength, light-weight composites
- CNT structures grow on coated substrate surface with desired orientation
- Alignment of structures can be controlled
- Provides mechanical strength and electrical or thermal conductivity

technology solution

THE TECHNOLOGY

This technology provides separate procedures for generating and aligning growth of an array of SWCNTs, an array of MWCNTs and/or an array of CNFs), with a CNT or CNF length that depends upon the structure involved,generally in the range of 1 to 100 micrometer (um). In one embodiment, an array of SWCNTs is grown by providing a substrate, coated on a first substrate surface with an optional first thickness (at least 1 to 10 um) of a metal underlayer and coated with a second thickness (at least 0.1 to 5 um) of one or more active catalysts. An electrode having an associated voltage magnitude in a range of 0.1 to 100 volts, or higher is connected to the substrate first surface or to a substrate second surface for a time interval of selected length in the range of 1 to 100 sec, or higher. In a first alternative, the electrode is then removed or disconnected; in a second alternative, the electrode is allowed to remain connected. A selected heated hydrocarbon gas (e.g., CH4, C2H4, and/or C2H2) intermediate species (CmHn) is passed over the coated substrate to successively strip the H atoms and deposit the carbon particles on the catalyst. Connection of the electrode, even for a time interval as short as a few seconds, will result in CNTs or CNFs that are oriented in substantially the same direction, roughly perpendicular to the coated substrate surface, having CNT lengths in a range of 1 to 1000 um. CNT orientation occurs whether the electrode remains connected to the substrate or is disconnected from the substrate.



Tower of multi-walled CNTs

APPLICATIONS

The technology has several potential applications:

- Electronics and computers
- Field emitter devices
- Sensors and electrodes
- Thermal protection/cooling systems
- Semiconductor industry
- Micro-energy storage devices
- Heat exchangers in electrical circuits
- Nanotechnology
- Optics

PUBLICATIONS

Patent No: 7,288,490

More Information

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