National Aeronautics and
Space Administration

Advanced Single-Wall Carbon Nanotubes

State-of-the-art materials for manufacturing stronger, lighter weight, and custom-designed automotive components

TECHNOLOGY OPPORTUNITY

Scientists at NASA's Glenn Research Center have developed a method of modifying single-wall carbon nanotubes (SWCNTs) capable of exhibiting excellent dispersion within a polymer matrix. The resulting composite offers improved mechanical, thermal, and electrical properties for use in automotive applications (as compared to conventional polymers or polymers with unmodified SWCNTs). This technology provides better strength, stiffness, stability, and higher conductivity than conventional reinforcement materials. These ultralightweight, high-strength composite materials are ideal for fabrication of lighter weight race cars, automobile components, flywheels, and more.

BENEFITS

- **Lightweight:** Can increase efficiency and reduce fuel consumption 15 to 25 percent
- **Clean, green technology:** Requires no solvents
- **Higher tensile strength:** 100 times the strength of steel
- **Custom designed materials:** Offers a variety of user-specified mechanical, electrical, and thermal material properties
- **Higher glass transition temperatures:** Allows material to maintain its strength at higher temperatures
- **Increased conductivity:** Improves the power density of materials in electronic devices

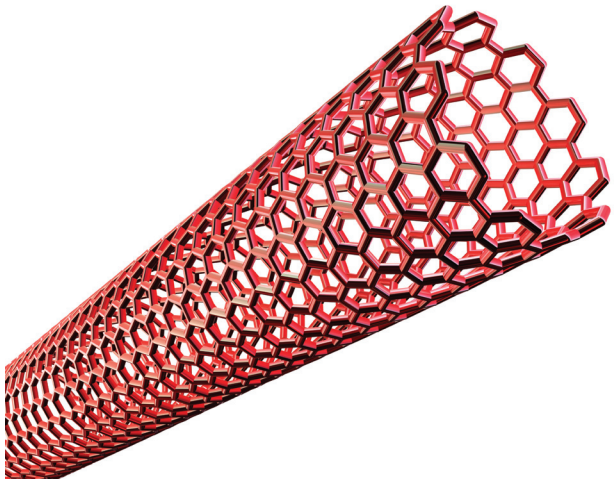
APPLICATIONS

These technologies are beneficial for making lightweight composite structures that require good strength and conductivity. Potential applications include:

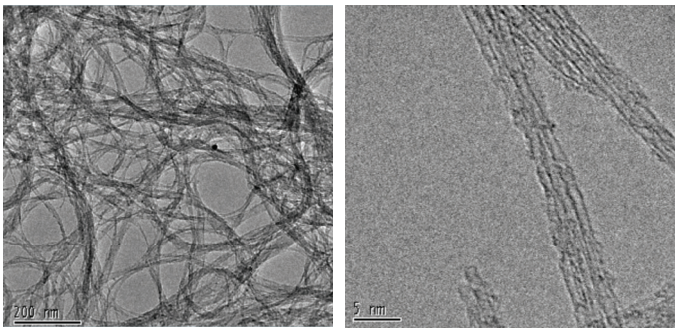
- High-performance race cars
- Lighter weight automobile components (e.g., chassis and body panels)
- Electrical cables and wires
- Ultracapacitors
- Flywheels
- Springs

HOW IT WORKS

A variety of polymers, including epoxies, have been used to prepare carbon nanotube (CNTs) polymer nanocomposites with the aim of obtaining enhanced mechanical, thermal, and electrical properties. An important requirement for the effective use of carbon nanotubes as reinforcements is the ability to homogenously disperse the nanotubes in the polymeric material. NASA has developed non-covalently modified single-wall carbon nanotubes that allow homogeneous dispersion of the SWCNTs throughout the polymeric resins. This aids in efficient load transfer, which is necessary for the desired improvement in mechanical properties, and also produces nanocomposites with optimum electrical conductivity.



Single-wall carbon nanotubes.



TEM, purified single-wall nanotubes.

WHY IT IS BETTER

Single-wall carbon nanotubes have the ability to behave like metals or semiconductors, conduct electricity better than copper, transmit heat better than diamond, and they rank among the strongest materials on Earth. NASA's modified SWCNTs allow better dispersion throughout the polymer matrix, which leads to superior properties in the resulting polymer composite. The resulting materials possess excellent strength, stiffness, stability, and high conductivity (both thermal and electrical). Their high modulus and low weight make SWCNTs ideal reinforcements in ultra lightweight, high-strength, and stiffness composite materials (e.g., high-performance race car components). In addition, the ability to enhance thermal and electrical conductivity as well as mechanical properties opens the possibility of utilizing SWCNTs in the development of multifunctional materials; e.g., for onboard electrical systems embedded in automotive body panels.

LICENSING AND PARTNERING OPPORTUNITIES

Glenn's Office of Technology Partnerships and Planning seeks to transfer technology to and from NASA to benefit the space program and U.S. industry. NASA invites companies to consider partnerships with Glenn developing applications for its Advanced Single-Wall Carbon Nanotubes.

FOR MORE INFORMATION

For more information about this and other technology licensing opportunities, please contact

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