Carbon Nanotubes

専門家に尋ねる

What is a Carbon Nanotube?
A Carbon Nanotube is a tube-shaped material, made of carbon, having a diameter measuring on the nanometer scale. A nanometer is one-billionth of a meter, or about one ten-thousandth of the thickness of a human hair. The graphite layer appears somewhat like a rolled-up chicken wire with a continuous unbroken hexagonal mesh and carbon molecules at the apexes of the hexagons.
Carbon Nanotubes have many structures, differing in length, thickness, and in the type of helicity and number of layers. Although they are formed from essentially the same graphite sheet, their electrical characteristics differ depending on these variations, acting either as metals or as semiconductors.
As a group, Carbon Nanotubes typically have diameters ranging from <1 nm up to 50 nm. Their lengths are typically several microns, but recent advancements have made the nanotubes much longer, and measured in centimeters.
Carbon Nanotubes can be categorized by their structures:

- Single-wall Nanotubes (SWNT)
- Multi-wall Nanotubes (MWNT)
- Double-wall Nanotubes (DWNT)

What are the Properties of a Carbon Nanotube?
The intrinsic mechanical and transport properties of Carbon Nanotubes make them the ultimate carbon fibers. The following tables (Table 1 and Table 2) compare these properties to other engineering materials.
Overall, Carbon Nanotubes show a unique combination of stiffness, strength, and tenacity compared to other fiber materials which usually lack one or more of these properties. Thermal and electrical conductivity are also very high, and comparable to other conductive materials.

Table 1. Mechanical Properties of Engineering Fibers

Fiber Material	Specific Density	E (TPa)	Strenght (GPa)	Strain at Break (%)
Carbon Nanotube	1.3 - 2	1	10 - 60	10
HS Steel	7.8	0.2	4.1	< 10
Carbon Fiber - PAN	1.7 - 2	0.2 - 0.6	1.7 - 5	0.3 - 2.4
Carbon Fiber - Pitch	2 - 2.2	0.4 - 0.96	2.2 - 3.3	0.27 - 0.6
E/S - glass	2.5	0.07 / 0.08	2.4 / 4.5	4.8
Kevlar* 49	1.4	0.13	3.6 - 4.1	2.8

Kevlar is a registered trademark of DuPont.

Table 2. Transport Properties of Conductive Materials

Material	Thermal Conductivity (W/m.k)	Electrical Conductivity
Carbon Nanotubes	> 3000	106 - 107
Copper	400	6 x 107
Carbon Fiber - Pitch	1000	2 - 8.5 x 106
Carbon Fiber - PAN	8 - 105	6.5 - 14 x 106

What are the Potential Applications for Carbon Nanotubes?
Carbon Nanotube Technology can be used for a wide range of new and existing applications:

- Conductive plastics
- Structural composite materials
- Flat-panel displays
- Gas storage
- Antifouling paint
- Micro- and nano-electronics
- Radar-absorbing coating
- Technical textiles
- Ultra-capacitors
- Atomic Force Microscope (AFM) tips
- Batteries with improved lifetime
- Biosensors for harmful gases
- Extra strong fibers

How Does Nanocyl Produce Carbon Nanotubes?

Nanocyl uses the "Catalytic Carbon Vapor Deposition" method for producing Carbon Nanotube Technologies. This proven industrial process is well known for its reliability and scalability. It involves growing nanotubes on substrates, thus enabling uniform, large-scale production of the highest-quality carbon nanotubes worldwide.

Which Carbon Nanotube Technology is Right for Your Application? Choose by:

- **Sectors**
- **Materials**
- **Products**