Length Separation of Carbon Nanotubes by Centrifugation in Dense Liquid

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Researchers at NIST have developed a method for length separation of single wall carbon nanotubes (SWCNT) using a high speed centrifuge to sort mixtures of nanotubes into different lengths. SWCNTs are rolled up sheets of graphite one atom thick and about a nanometer in diameter with remarkable features including extraordinary strength and unique electronic, optical, and mechanical properties. Worldwide demand for carbon nanotubes is growing rapidly with applications in fields including electrical, medical, and mechanical.

The method for manufacturing SWCNTs results in nanotubes of an enormous range of lengths, from a few tens or hundreds, up to thousand of nanometers. To effectively use carbon nanotubes for many potential applications, they need to be economically sorted by length. In biomedical applications, for example, it has been shown that whether or not nanotubes are taken up in the cell depends critically on length.

The NIST technology allows the economical sorting of single wall carbon nanotubes (SWCNTs) by length. The technology works for all SCWNT types. Length separation of single wall carbon nanotubes (SWCNT) has traditionally been a difficult and expensive process. NIST scientists have developed a simple, scalable, process that exploits the hydrodynamic and gravitational forces inherent in nanotube dispersion. The NIST process first employs sonication to individualize the SWCNT in a common surfactant followed by a short centrifugation to remove debris and other contaminants. The polydispersed SWCNT fraction is then mixed with an additional polymer and surfactant and centrifuged to cause the nanotubes to separate depending upon their length. After centrifugation the differing length fractions can be collected from respective layers. Additional concentration of the desired length SWCNTs and their separation from the polymer carrier can be effected by conventional techniques. The centrifugation process is scalable to large volumes, is low cost, and doesn't require expensive auxiliary equipment. Length separation provides for improved conductivity and percolating matrix networks, important advantages in many applications.

Reliable technology to separate SWCNTs by length from a heterogeneous yield is of great commercial value in terms of providing homogeneous batches for industrial applications. At present, there are many development efforts to perfect such separation technology. This is one of the best and should serve to drive down the cost of producing homogeneous SWCNT batches. Exact nature of revenue stream or size is unknown at present.

This technology is immediately available for licensing and commercialization.