Direct Spinning of Carbon Nanotube Fibers from Chemical Vapor Deposition Synthes

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Science publishes an article by Alan H. Windle and co-workers . Many routes have been developed for the synthesis of carbon nanotubes, but their assembly into continuous fibers has been achieved only through postprocessing methods.
In his article Mr. Windle says that they spun fibers and ribbons of carbon nanotubes directly from the chemical vapor deposition (CVD) synthesis zone of a furnace using a liquid source of carbon and an iron nanocatalyst. This process was realized through the appropriate choice of reactants, control of the reaction conditions, and continuous withdrawal of the product with a rotating spindle used in various geometries. (Science, Vol 304, Issue 5668, 276-278, 9 April 2004)

Macroscopic assemblies of carbon nanotubes are desired for a wide range of applications, including composites, micromechanical actuators, power cables, electrodes, and catalyst supports. Considerable research has been directed toward producing assemblies of aligned nanotubes, with the object of obtaining good properties in one or more directions. To date, attention has focused on the postprocessing of dispersed nanotubes by drying to produce films, coupled with electric or magnetic fields. Similarly, fibers of nanotubes or nanotube-polymer blends have been drawn or spun from solutions or gels. It has also been demonstrated that a thread of nanotubes can be dry-drawn from an aligned assembly on a silicon substrate, underlining the ability of nanotubes to assemble as a result of van der Waal interactions. Recently, Zhu et al. have reported the formation of a 20-cm-long nanotube thread after the pyrolysis of hexane, ferrocene, and thiophene. Although this work shows the

possibility of fiber formation directly in a furnace, the product was isolated strands.

By mechanically drawing the carbon nanotubes directly from the gaseous reaction zone, authors have found it possible to wind up continuous fiber without an apparent limit to the length. If this fiber can challenge conventional high-performance fibers for properties, its simpler method of production will commend it on both cost and environmental grounds. The key requirements for continuous spinning are the rapid production of high-purity nanotubes to form an aerogel in the furnace hot zone and the forcible removal of the product from reaction by continuous wind-up.