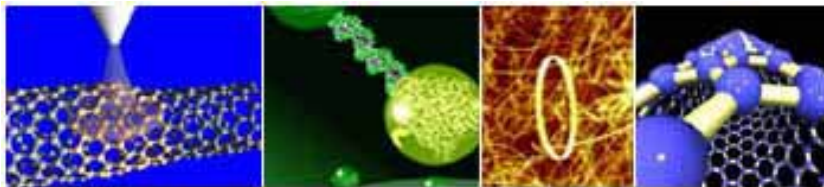


## Nanotech Alert

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## CONTROLLING SWNT SELF-ASSEMBLY USING DNA SEQUENCES

In pursuing self-assembly techniques for nanoscale materials, it's logical to consider using DNA. After all, DNA is a self-assembler par excellence. Researchers have discovered that DNA can be used to guide self-assembly of gold nanoparticles into various configurations. However, using DNA to induce carbon nanotubes to self-assemble has been a trickier proposition. Now, a team from the University of Science and Technology of China (USTC) has developed a technique that uses DNA-wrapped single-walled carbon nanotubes (SWNTs) to make a self-assembly system. Further, by grafting hybridizable DNA sequences onto these DNA-wrapped SWNTs, it's possible to reverse the self-assembly process.

The USTC team is Yulin Li, Xiaogang Han, and Zhaoxiang Deng of the Department of Chemistry. To find out how this process works, *Nanotech Alert* spoke with Deng, a professor of chemistry.

*Nanotech Alert: How did the idea for the grafting of DNA come about?*

Deng: As one of the research groups working in DNA nanotechnology, some of our interests lie at the interface between soft (biomolecules) and hard (solid) materials. The idea to graft DNA onto carbon nanotubes came to us in a very natural way, as we always struggle to find more DNA functionalized units that can be used for DNA-programmed material assembly, based on which more complicated structures for electronics or sensor applications might be expected.

It was an exciting moment when we saw, for the first time, that two parts of carbon nanotubes grafted with complementary DNA tails could hybridize with each other to form aggregates within minutes. These aggregates could then be disrupted back into dispersed phases by a simple strategy called strand-displacement that is familiar to DNA nanotechnologists.

*Nanotech Alert: Could you explain how the process works?*

Deng: The process works in two simple steps: (1) SWNTs are dispersed into water by wrapping them with a primary disperser strand of DNA under the action of sonication; (2) A secondary hybridization strand is then added, in excess amount, to the DNA wrapped and dispersed carbon nanotubes so that it can gradually hybridize with one segment of the disperser strand on the carbon nanotubes over an elongated incubation time, say, overnight. Immediately following each step, the free unconjugated DNA molecules in the solution could be removed by discarding the supernatant solution after a high-speed centrifugation. The pellet containing DNA grafted carbon nanotubes is then redispersed in a recovery buffer solution.

*Nanotech Alert: What's next in terms of research?*

Deng: Since the DNA strands grafted on carbon nanotubes remain very good hybridizability, we are planning to explore more realistic applications of this new material. Some of them include building sensors using the hybridization-induced aggregation assay. Also, we are working hard toward further assembly of the carbon nanotubes into more complicated structures by using well-developed DNA nanotechnologies to build assembly scaffolds and using DNA hybridization to drive the self-assembly of carbon nanotubes into defined structures.

*Nanotech Alert: Are there any particular applications that would benefit from this technique?*

Deng: The technique might provide a new platform so that application-oriented research may now move on. This type of research has been bottlenecked due to the lack of a suitable method to obtain highly hybridizable carbon nanotubes. The building of a sensor assay as mentioned above is one such example.

Another application that might be more interesting is the parallel integrations of carbon nanotubes into functional nanoelectronic devices. For sure, further efforts toward modifying the carbon nanotubes with extra functional groups as well as making the carbon nanotubes more purified are definitely necessary. There might be other unforeseen technical issues associated with the application of this technique, which might be encountered before finally moving into these applications.

To learn more about the work, see the journal *Angewandte Chemie International Edition*, vol. 46, No. 39: pp. 7481-7484 (2007). The work is supported by the National Natural Science Foundation of China and the University of Science and Technology of China.

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