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Bubbles offer solution to nanotube tangles

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Tom Simonite

Blowing bubbles could provide a surprising solution to the problem of separating and aligning tangled nanowires and nanotubes. It could perhaps even result in new ways of producing nanoscale electronic components, such as transistors.

Once nanotubes have been fabricated, they are extremely difficult to arrange and order. Finding a way to do so should make it easier to harness the novel optical and physical properties of such nanomaterials.

Guihua Yu and Charles Lieber of Harvard University, and Anyuan Cao of the University of Hawaii, US, used nitrogen gas to blow bubbles of an epoxy polymer containing silicon nanowires, single-walled carbon nanotubes or multi-walled carbon nanotubes, and caught the resulting film on a surface.

They then examined the resulting film under both optical and electron microscopes, revealing that the nanowires and nanotubes had become neatly lined up and evenly spread out across the surface.

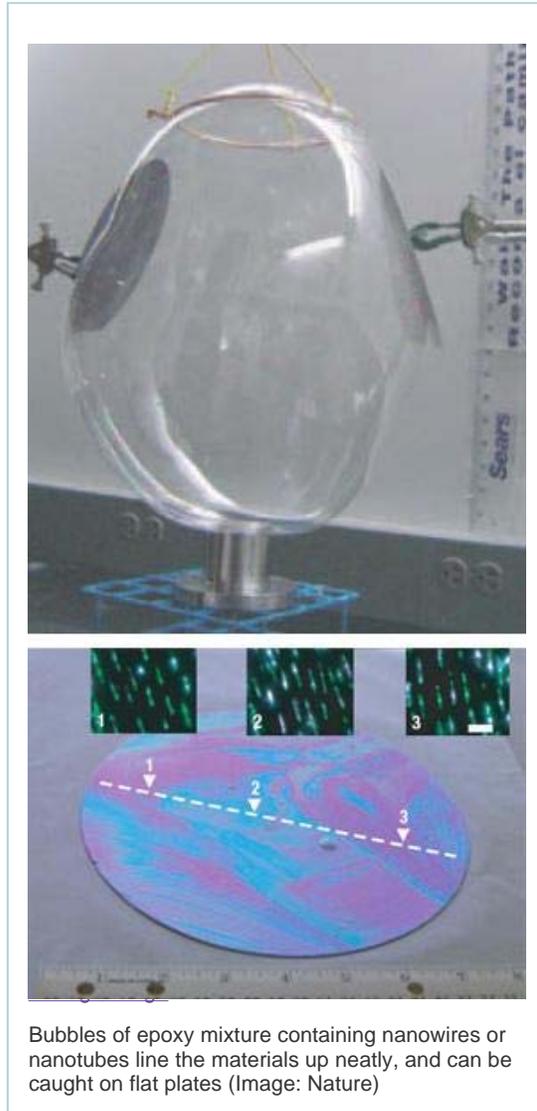
Bubble catcher

Bubbles were produced by pouring the epoxy mixture over a metal plate with a gas inlet at the centre. Turning on the gas creates a bubble and a metal ring above the plate catches hold as it grows. As the bubble expands to more than 25cm wide and 50cm tall, portions of film are deposited on surrounding pieces of flat silicon or plastic.

The nanomaterials contained in the mixture were found to have aligned themselves vertically, towards the top of the bubble. Varying the concentration of tubes or wires in the mixture altered the density of nanomaterials but not their alignment.

Exactly why the tubes line up is not known, although the researchers suspect that stress generated on the surface of the bubble, as it expands, pulls the tubes and wires into line. They add that having a simple way to align nanowires and nanotubes with a particular density could help integrate such components into electronic and optical devices.

To prove this, the team created arrays of transistors using bubbles containing silicon nanowires. Electrodes and an additional layer of insulator were patterned onto a plate coated



Bubbles of epoxy mixture containing nanowires or nanotubes line the materials up neatly, and can be caught on flat plates (Image: Nature)

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using the bubble technique to make many field effect transistors that exploit the semiconductor properties of the nanowires.

Deflated dreams

Alan Dalton and Izabela Jurewicz, nanotechnology researchers from Surrey University in the UK, wrote an article about the research, which is published in the same issue of the journal *Nature Nanotechnology*. They say the technique could help tackle "a major bottleneck in efforts to commercialize this technology."

"Materials scientists have spent the last decade dreaming of an effective and scalable method to fabricate high-performance nanocomposite films, only for these dreams to be, in general, ultimately deflated," the researchers write.

They add that it will be important to gain greater understanding of the process, but believe that ultimately, "the production of nanowire and nanotube films using blown-film extrusion will be an important advance for many application areas."

Journal reference: *Nature Nanotechnology* (DOI:10.1038/nnano.2007.150)

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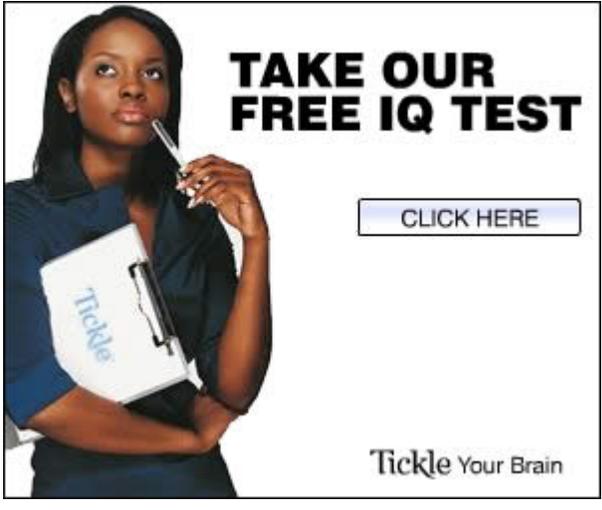
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