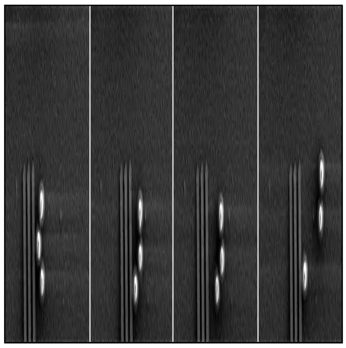
Nanotube 'forest' makes super slippery surface

News Story Origin and Copyright: ***New Scientist***

Posted by: **Tomyhoi**
Date: **September 15th 2006**
For the original release **click here.**

The researchers used tiny levers to push 5-micron-wide polystyrene beads over a nanotube surface
A material less sticky than Teflon has been created by covering a surface with a "forest" of carbon nanotubes. It could find use in the construction of microscopic machines and devices, which are prone to inter-molecular forces.
Microscopic structures experience friction because of the minute attractive forces that exist between molecules. These forces become much more significant as components are shrunk to the scale of a few millionths of a metre.
Now researchers from Cambridge University in UK, the Technical University of Denmark and the University of Southern Denmark have found a way to reduce this friction. They discovered that coating a work surface with upright carbon nanotubes allows microscopic components to be moved across the surface more easily.



The researchers used tiny levers to push 5-micron-wide polystyrene beads over a nanotube surface

The team coated a silicon wafer with a layer of upright nanotubes, spaced 100 nanometres apart through a process called chemical vapour deposition. This produced a thick "forest" of tubes, with each tube 1000 nm tall and 100 nm wide.

Playing field
The researchers then used tiny levers to push 5-microns-wide polystyrene beads over the surface (see image). They repeated the test on flat surfaces of gold, silicon, diamond-like carbon and Teflon. They found the nanotube-covered surface to be four times less sticky than its nearest rival, Teflon.

"Soft latex beads that were stuck onto Teflon could be pushed around on the nanotube forests like a soccer ball on a playing field," Peter Bøggild from the Technical University of Denmark told New Scientist.

Moving the bead across the nanotube-forest surface took 0.2 micronewtons of force, compared to 1.1 mN on the Teflon surface or more than 1.4 mN on the gold or silicon surface. One micronewton is roughly the force needed to lift one-tenth of a gram.

Friction is reduced because the tip of each tube only touches a small part of the object above. "Anything on a nanotube forest is practically suspended in the air," Bøggild explains. To lift something off the non-stick surfaces, the researchers simply used a stickier surface to grab the object.

Stick and tear
In another experiment, Ken Teo from Cambridge University and colleagues were able to manipulate an organic nanofibre laid across the top of the nanotubes. Organic nanofibres show potential for use in nanoelectronics but are soft and fragile and have never been manipulated so deftly before, he says.

"People have so far had to push them around like hockey," says Teo. "But a lot of the time they either stick or tear." The researchers picked up the nanofibre by pushing a probe into the "forest" beneath the fibre and lifting it upwards.

"The tubes are like grass, you can push into them," says Teo. The researchers demonstrated how this could be applied by moving the nanofibre from the nanotube surface onto a set of electrodes to test its electrical properties.

"Adhesion of solids is a big problem at this scale," says Tommy Horozov, a chemist at Hull University, UK. "This shows how to solve a long lasting problem with manipulating solid objects." The nanotube-covered surface could make it easier to work with soft material like cells, he suggests.

Horozov has used a similar technique to produce water-repellent, so-called self-cleaning surfaces (see Anti-fog glass coating has clear applications). "This is the same approach but with a dry surface," he says.