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## Self-assembling nano-boxes show chemical control

15:24 21 August 2006  
 NewScientist.com news service  
 Tom Simonite

Microscopic metal boxes that hold a few nanolitres of liquid each have been developed by US researchers. They say the tiny containers could someday be used for precision chemistry or even drug delivery inside the body.

The tiny boxes are made from flat templates that self-assemble due to liquid surface tension during the production process. Once constructed, they can be also moved around remotely using magnetic fields. This means they could carry small chemical samples around or possibly even deliver drugs within the human body, the researchers say.

"We have shown that we can bring two or more of them together to allow the chemicals they hold to react," explains researcher David Gracias, a chemical engineer at Johns Hopkins University, US.

### Flat pack

The sides of each box are made using an established manufacturing method called electrodeposition. This involves chemically depositing layers of nickel on top of a polymer-coated silicon wafer and then applying an electric current to bind them together.

The metal template is then released from the silicon layer. This is done by heated the boxes briefly to 250 °C which dissolves the polymer layer in-between. "The 'solder' melts and the very high surface tension causes the liquid to contract and fold the templates spontaneously into 3D boxes," Gracias says.

As the boxes are made from nickel, they are magnetic, which means they can be moved around using magnetic fields. "We've shown previously that these boxes can be imaged inside living cells using an MRI scanner," Gracias says. "Now we've demonstrated we can guide them in any trajectory using a magnetic stylus." A video shows a box filled with a compound that reacts with the surrounding liquid to make a pink compound being moved around (Video: David Gracias/ACS, DivX required).

### Micro-pipettes

The researchers have made various microscopic structures, including open and closed cubes, measuring about 100 micrometers on each side, and tetrahedrons. They have also built nano-containers with capacities ranging from 230 picolitres (trillionths of a litre) to 8 nanolitres (billionths of a litre). These can be filled either by dunking them into a substance or filling them up using microscopic pipettes. The rate at which material leaks out of the containers can be controlled by punching different sized holes in their sides using lithography to create a pattern of holes and chemistry to create them.

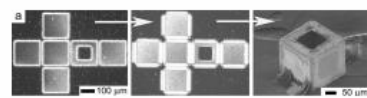
Gracias believes the boxes could provide a useful addition to microfluidic chips, which use tiny channels to direct chemicals around. "These boxes are reconfigurable," Gracias says. "Once you've made your [microfluidic] chip you're stuck with it."

Another, more futuristic application is targeted drug-delivery inside the body. "We have done preliminary studies in mice and found no toxic effects so far," he told **New Scientist**.

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Enlarge image  
 The tiny boxes fold themselves into shape when heated to 250 degrees celcius (Image: David Gracias/ACS)

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