

Driving water droplets uphill

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Lab-on-a-chip technology could soon simplify a host of applications, thanks to a new way to move droplets up vertical surfaces on flexible chips.

Canadian chemists have developed an all-terrain droplet actuation (ATDA) method to move droplets across chips at a wide range of angles. Aaron Wheeler and colleagues at the University of Toronto say digital microfluidic devices using ATDA could be used to move fluids rapidly between different environments, for example to cycle between heating and cooling, in research published in the Royal Society of Chemistry journal *Lab on a Chip*.

Wheeler developed ATDA on flexible, water-repellent polyimide surfaces, clad with copper, which can be bent into a variety of shapes including steps, twists and overhangs. The fluid beads are moved by sequentially activating a series of electrode pairs, which is thought to pull the droplet forward by reducing water repellence in front of the droplet. This process gives the team full control of the droplet, including up and down vertical surfaces.

Wheeler suggest several potential uses for the technique, including PCR (the polymerase chain reaction), which is used in DNA analysis. PCR depends on rapid temperature cycling - and Wheeler showed the method can be used to move fluids between a cooling structure and a hot plate. Automating the droplet movement would allow very rapid temperature cycling, Wheeler adds. The team also showed ATDA devices can be used to extract DNA from a complex organic mixture. By half-

immersing the device in the mixture, and driving the water droplet in and out of it, the process could automate a tedious technique molecular biologists use to purify DNA, says Wheeler.

Richard Fair, who studies lab-on-a-chip devices at Duke University, Durham, US, says it is too soon to tell whether all-terrain devices will be useful. 'Demonstrating these applications is kind of cool, but whether ATDA is the best way to do them is another issue,' he says.

Wheeler agrees that the ultimate uses of ATDA are still to be established. 'What this will be good for, frankly we're not 100 per cent sure, but it's been fun to do something new,' he says. 'For example, this certainly isn't the only way to cycle temperature on a lab on a chip device. The point we're trying to make is that it's really easy - we can take this flexible substrate, and in a matter of minutes have a temperature gradient simply by sticking part of it on an external heater.'

Citation: Mohamed Abdelgawad, Sergio L. S. Freire, Hao Yang and Aaron R. Wheeler, *Lab Chip*, 2008, DOI: 10.1039/b801516c

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