Electrogates offer stop-and-go control in microfluidics

April 24 2018, by Lisa Zyga

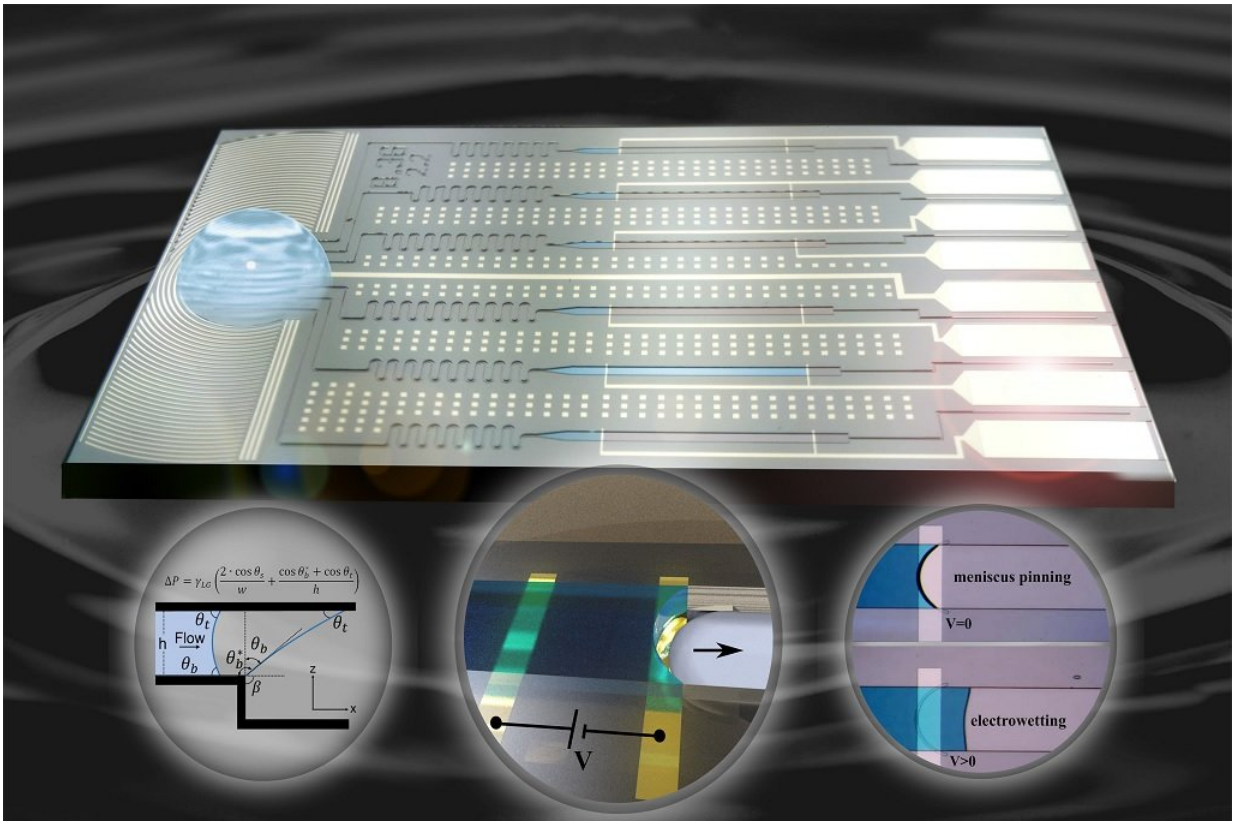


Illustration of electrogates. Insets show a close-up of the area surrounding the trench. Credit: IBM Research-Zurich

Although microfluidics devices have a wide variety of uses, from point-of-care diagnostics to environmental analysis, one major limitation is

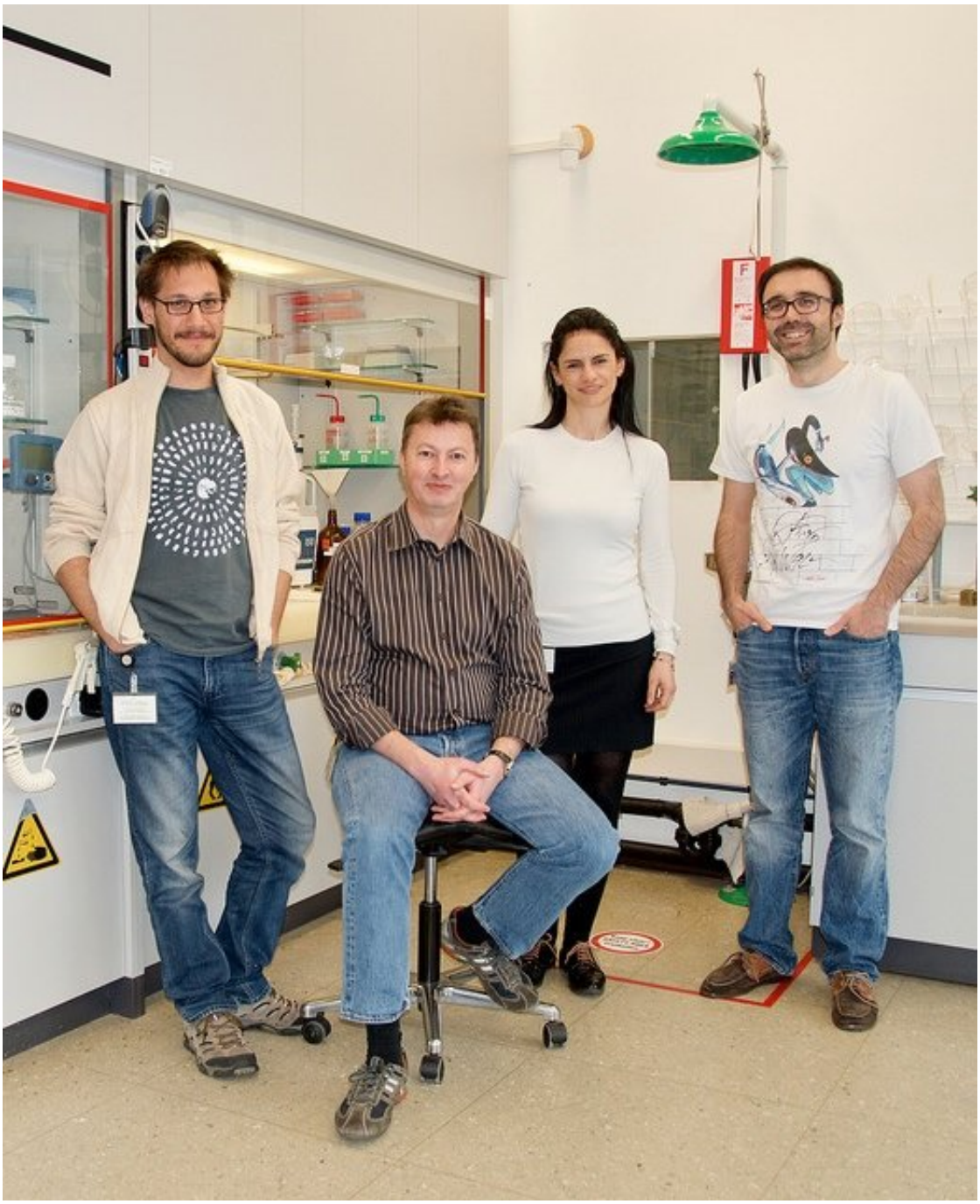
that they cannot be modified for different uses on the fly, since their flow paths are set during fabrication. In a new study, researchers have addressed this limitation by designing electrogates that can regulate the flow of liquid at different points along the microchannel—a process that can be entirely controlled with a smartphone.

The researchers, Y. Arango, Y. Temiz, O. Gökçe, and E. Delamarche, at IBM Research-Zurich in Rüschlikon, Switzerland, have published a paper on electrogates in a recent issue of *Applied Physics Letters*.

"Point-of-care diagnostics represent a very segmented market," Delamarche told *Phys.org*. "For each type of test, a microfluidic device needs to be designed and fabricated to ensure optimal assay performances (volume of sample passing through the device, flow rates, time given for the reactions to take place, time given for dissolving some reagents in the chip with the sample, etc.). This is a bit frustrating, and with silicon microtechnology, it is always beneficial to cover as many applications as possible without too much redesign and changes in the manufacturing processes.

"This is where electrogates help, and this is what motivated us to invent them. The idea is to make chips much more generic and transfer some of the routing and timing of the flow to a software level, i.e., a protocol uploaded on a smartphone or tablet. Changing protocols on a software level is easy, fast, flexible and convenient."

Rather than using mechanical elements such as pumps and valves to control the flow, the electrogates are based on electrowetting. This process involves applying an electric voltage to control the wetting properties of the surface, which in turn controls the flow of the liquid.



The researchers in their lab. Credit: IBM Research-Zurich

Each electrogate consists of a trench etched into the bottom surface of the microchannel, with one electrode patterned over the trench and a

second electrode patterned a short distance in front of the trench. When a liquid sample flows along the microchannel in the absence of a voltage, it stops at the trench because the abrupt change in the contact angle creates a pinning force on the liquid. A small voltage (