Tube-less microfluidics: supplementary information

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Video 1: Passive pumping. Eight channels molded in PDMS have been pre-loaded with water and each channel supplied with a 6μl output drop on the end further away from the video camers. One of the ports was supplied with at 10μl drop of water. Using a hand-held pipette a small amount of colored dye was dispensed at each of the ports producing flow that filled the channels with dye.

Video 2: An array of 192 microchannels interfaced with a 96-tip robotic pipetter. A 5 microliter drop of water is delivered at the right port of each channel in the array followed by a 3 microliter drop of dyed water at the left port, which immediately pumps into the channel.

Liquid bridge

Methods

A 75 mm x 50 mm new, glass microscope slide was placed over a device that would later be used for the underlying channels layer. Holes were drilled in the glass to form input and output ports through the glass. The slide was then placed in a glass petri dish filled with a 1:1 MeOH/HCl solution for 30 minutes, after which it was thoroughly rinsed with deionized water and dried with N_2.

An octadecyltrichlorosilane (OTS) solution was made by combining a 1:20 ratio of OTS and hexadecane. After mixing, a thin layer of OTS was placed on a polydimethylsiloxane (PDMS) channel layer mounted on a microscope slide. The dimensions of the channels in the PDMS were identical to the channels used as a guide for the input and output ports on the drilled slide. When positioning the drilled slide over the OTS-covered stamp, the drilled slide was staggered with respect to the channels (i.e. a PDMS channel connected two ports where the liquid connector was desired). The drilled slide was then pressed on the PDMS stamp for a few seconds, and carefully removed. The drilled slide was left for 5 minutes before rinsing with isopropyl alcohol and drying with N2.

The underlying part of the liquid connector device was constructed by placing a PDMS piece (with the same channel design) on a glass microscope slide. With the stamped side facing up and aligning the drilled holes with the input and output ports of the underlying channels, the device was completed by pressing the two halves together.

Results and discussion

A liquid bridge was formed as shown in figure 1. As shown in in figure 1 A-B the liquid bridge could be formed within the hydrophilic patterned area. Also, by incorporating a hydrophobic barrier between the ports, the liquid bridge could also be broken as shown in figure 1 C-D.

As in previously demonstrated for other applications of hydrophilic/hydrophobic patterning [1] (virtual walls) the patterned areas are very stable.

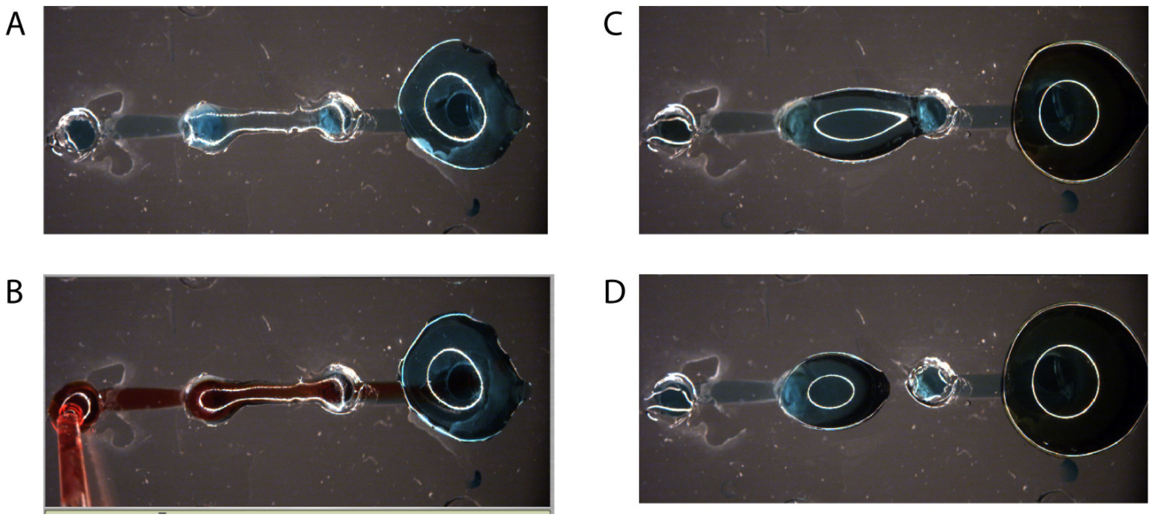

Figure 1: Liquid bridge. A) Two channels filled with blue dye and connected via a liquid bridge. B) Red dye flowed across the liquid bridge. C) Two channels connected via a liquid bridge. D) Liquid bridge disconnected due to hydrophobic surface patterning.

768 channel array

Methods

An array of 768 microchannels was produced in poly(dimethylsiloxane) (PDMS) from a silicon/SU-8 mold. The array was filled with water using vacuum [2]. An automated liquid handler (223 Sample changer, Gilson, WI) was programmed to transfer 1μl fluorescein isothiocyanate (FITC) solution from a 96 well plate to the microfluidic device.

Results and discussion

A specific channel in the array was successfully loaded with FITC as shown in figure 2. This demonstrates the scaling potential of the platform described in the paper.

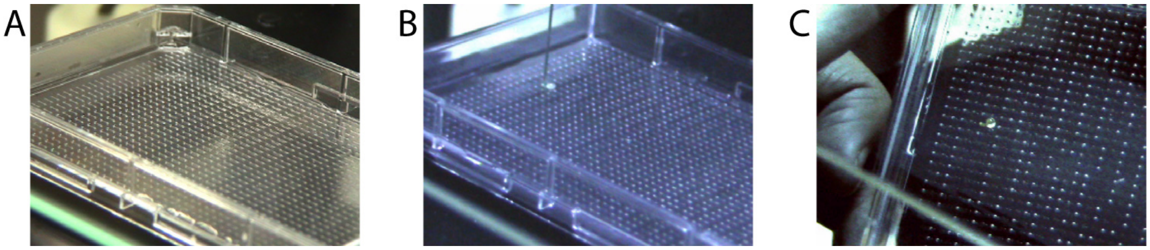

Figure 2: 768 channel array. A) The array with each channel filled with water. B) An automated liquid handler (223 Sample changer, Gilson, WI) delivering a FITC solution to a specific channel. C) The array held up to show the FITC-filled channel.

References

[1] B. Zhao, J. S. Moore, and D. J. Beebe, "Surface-directed liquid flow inside microchannels," *Science*, vol. 291, no. 5506, pp. 1023 – 1026, 2001.

[2] J. Monahan, A. A. Gewirth, and R. G. Nuzzo, "A method for filling complex polymeric microfluidic devices and arrays," *Analytical Chemistry*, vol. 73, pp. 3193 – 3197, 2001.