Supporting Information

Integrated pneumatic micro-pumps for high-throughput droplet-based microfluidics

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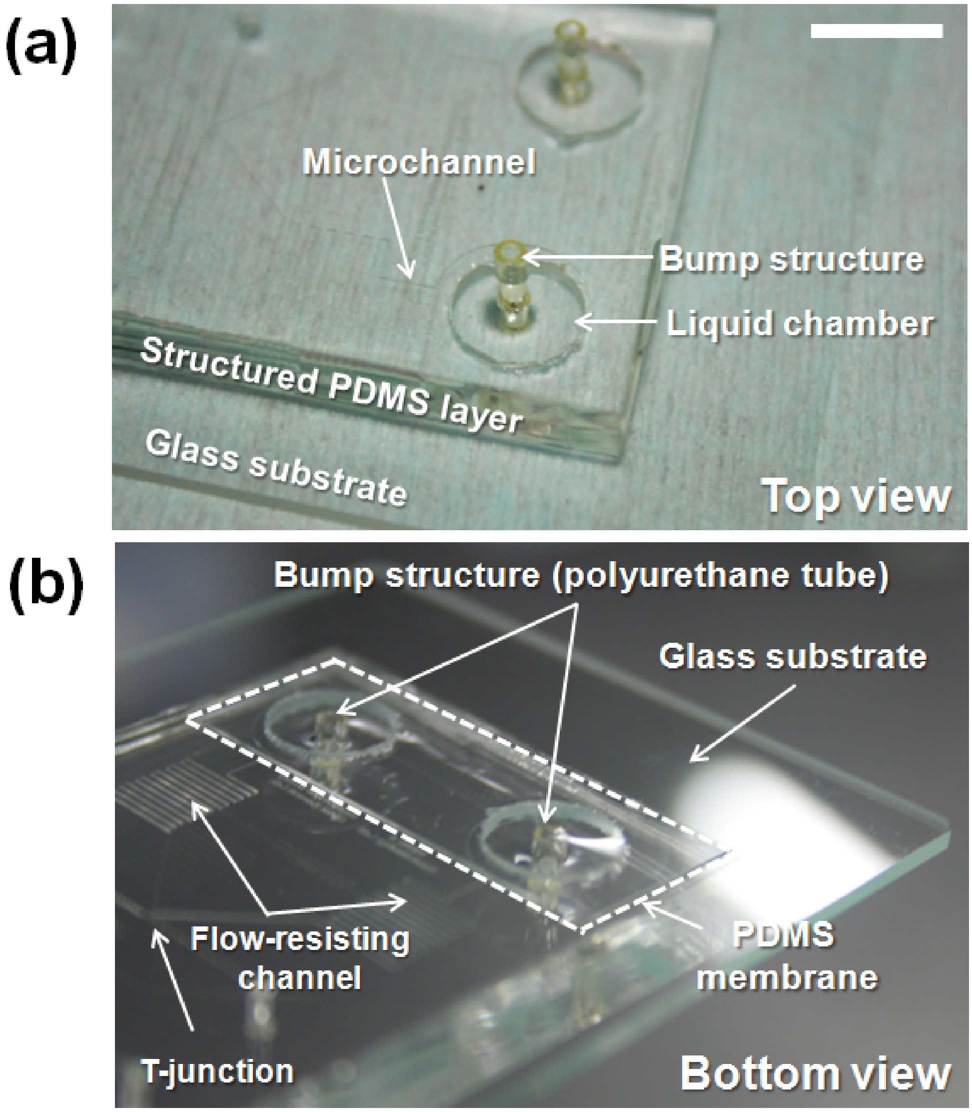

Fig. S1 Detailed image of channel and bump structure geometry in microfluidic chip for integrated pneumatic micro-pumps. (a) Top view and (b) bottom view of the microfluidic chip. All of microchannels are a 110 μm width and 70 μm height. The flow-resisting channels (about 3.5 mm in length) between the pumps and the T-junction prevent aqueous samples flowing backward from the T-junction to each other sample inlet. Bump structures in the liquid chamber are formed by using 2 mm outer diameter urethane tubes. Scale bar: 10 mm.

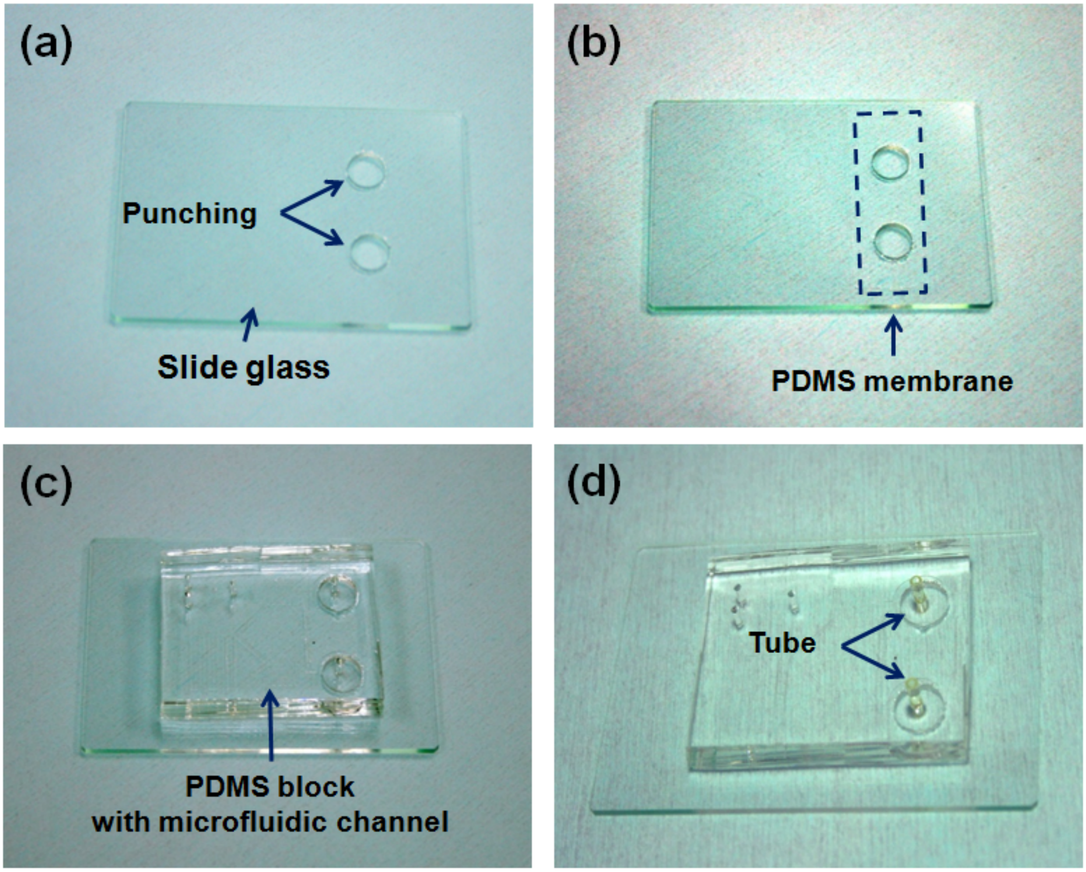

Fig. S2 Assemble process of microfluidic chip for integrated pneumatic micro-pumps. Firstly, (a) glass substrate was punched with 8 mm hole using milling machine. Secondly, (b) Flexible polydimethylsilixane (PDMS) membrane was attached on bottom side of slide glass. Thirdly, (c) PDMS block containing structured microfluidic channel was bonded on upside of slide glass after oxygen plasma treatment. Finally, (d) polyurethane tube was inserted into PDMS block.

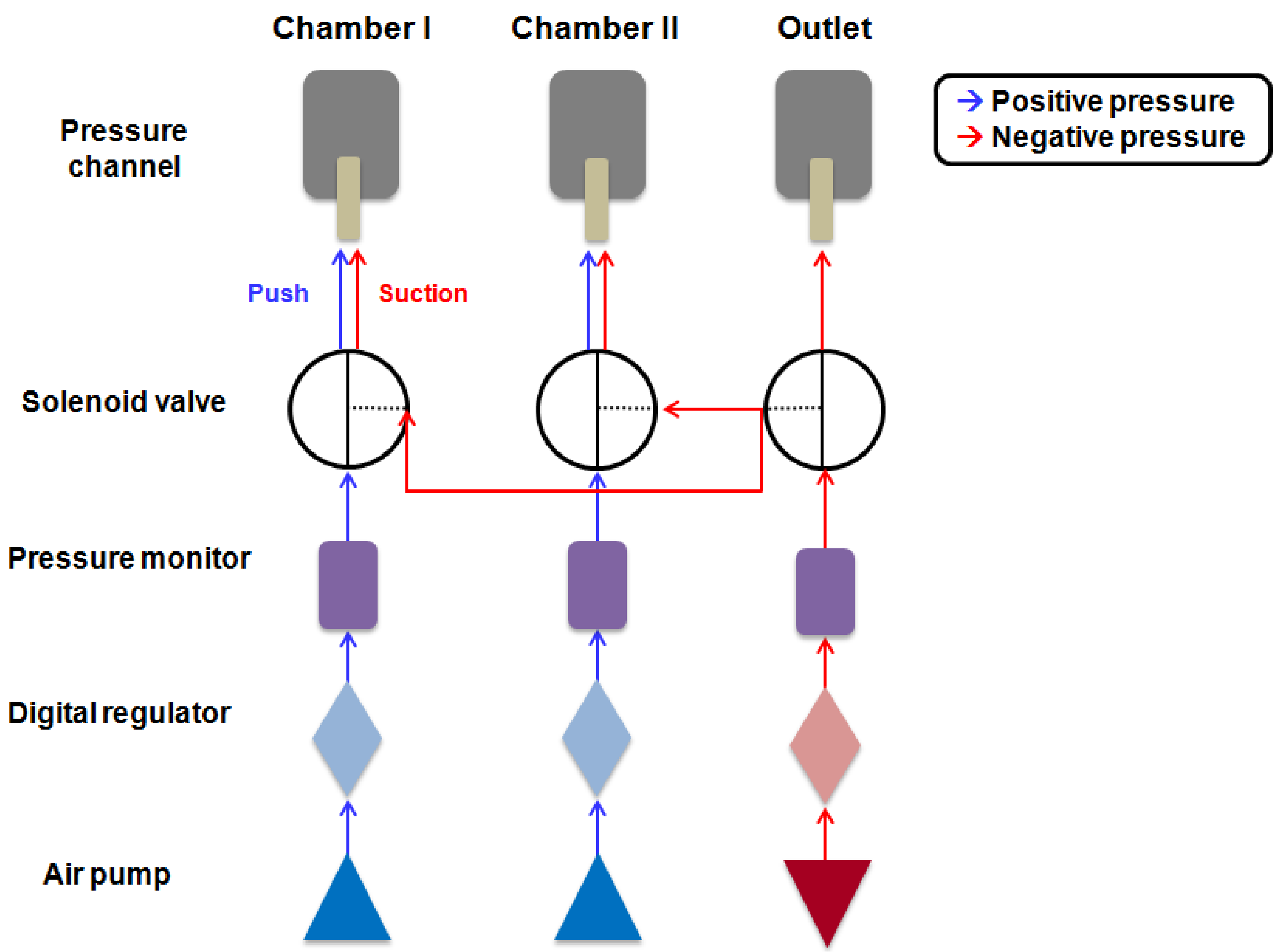

Fig. S3 Schematic of a pressure control system for the PDMS diaphragm actuations of the pumps. The applied positive and negative pressures are controlled with air pumps, digital regulators (ITV series, SMC Co., Noblesville, IN, USA), pressure monitors and a solenoid valve (LHD series, Lee Company, Westbrook, CT, USA). The digital regulators (i.e., electro-pneumatic and electronic vacuum regulators) control positive and negative (0.1 kPa per 0.01 V).

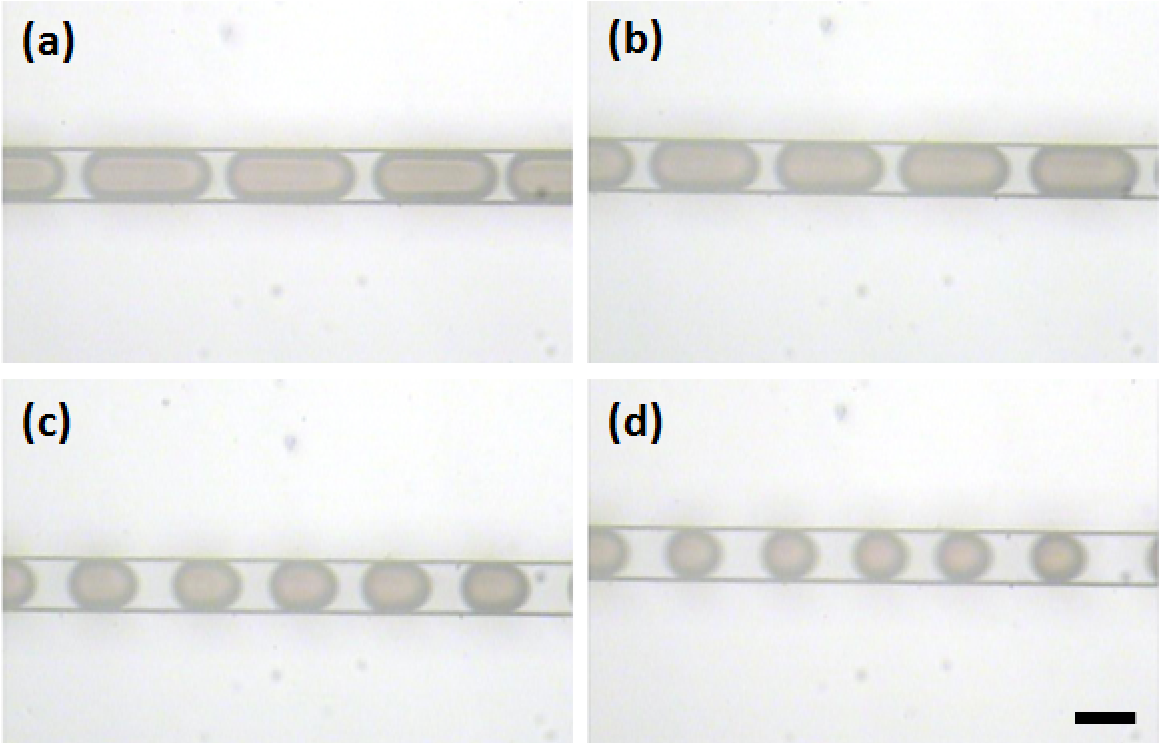

Fig. S4 An example images of generated microdroplets by dyed water using pneumatic pumps. In this experiments, positive pressure is increased 0 kPa to 10 kPa ((a) ~ (d)) against fixed negative pressure at -40 kPa. The generated microdroplets maintain uniformity under stable fixed pressure conditions. Scale bar: 100μm.