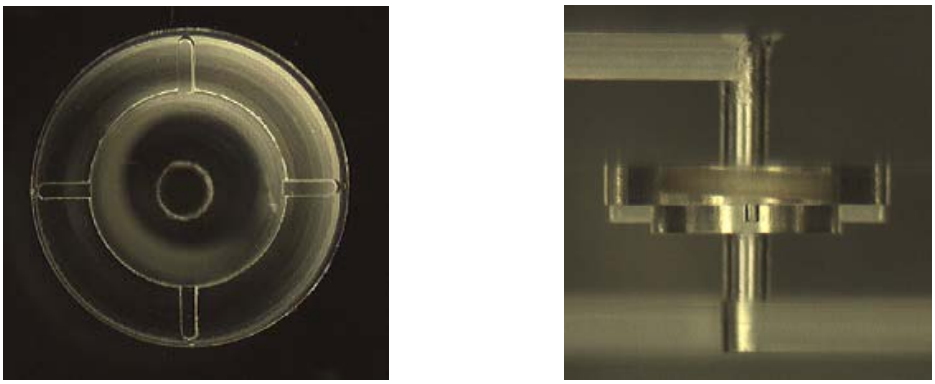
Electronic Supplementary Material (ESI) for Lab on a Chip

Supplementary Information

I: Figure



(a) (b)

Fig. S1 (a) Top view of the microfluidic oscillator before bonding (without the cover and diaphragm). (b) Front view of the device embedded into a chip using 4 layers of PMMA substrates. The structures were fabricated using a CNC micro-milling machine (Mini-Mill 3 Pro, Minitech Machinery, USA). As shown in Fig. 1A, the third layer contains most structures. In fabrication, the substrate was first drilled through to form the outlet. Then the oscillation chambers were fabricated through milling process. The groove channels were lastly machined using a micro end mill with a diameter of 150 μm (LPKF Laser & Electronics, Germany). The diaphragm, silicone (HT-6240, Rogers corporation, USA) or latex (cut from Kleen® hands examination gloves) rubber were cut using femto-second laser (CPA2001, Clark-MXR, Inc., USA). The PMMA substrates were bonded together through thermal bonding. Their surfaces were first cleaned using IPA (isopropyl alcohol). Then atmospheric plasma treatment was applied to facilitate the thermal interdiffusion process. The diaphragm was then placed inside the oscillation chamber. The substrates were aligned with the aid of a microscope, and they were fixed through applying a tiny volume of acrylic glue at their corners. After that, the substrates were sandwiched between two metal plates. The assembly was then put into a hydraulic pressure set with heating platens (Specac Ltd., UK). At temperature 103 ^{o}C, pressure 1.5 MPa, the substrates can be well bonded after around 20 mins.

II: Movies

Movie S1: Periodic displacement of the diaphragm at P_0 =1.0 bar for water, f = 94.5 Hz. Device details are given in the caption of Fig. 2.

Movie S2: Periodic displacement of the diaphragm at P_0=3.0 bar for, f = 142.4 Hz. Device details are given in the caption of Fig. 2.

Movie S3: Periodic displacement of the diaphragm at P_0=1.8 bar for 50vol% glycerol solution, f = 109.9 Hz. Device details are given in the caption of Fig. 2.

Movie S4: Mixing enhancement in oscillatory flow (f =173.4 Hz). Device details are described in the caption of Fig. 4.