Electronic Supplementary Material (ESI) for Lab on a Chip.
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Dielectrophoresis-actuated liquid lenses with dual air/liquid interfaces tuned from biconcave to biconvex

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Electronic Supplementary Information

S1. Device fabrication process

The device is fabricated using the lift-off process and UV assisted bonding technique. Below is the process flow.

S1.1 Lift-off fabrication procedure

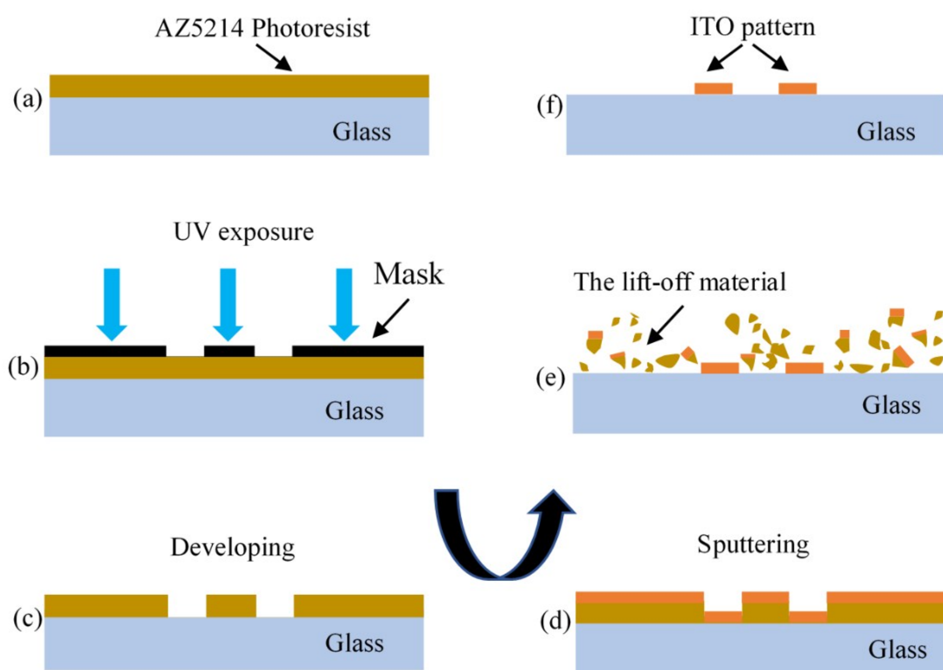

Fig. S1 Schematic diagram of the lift-off fabrication process: (a) AZ5214 photoresist is coated on the glass substrate. (b) Pattern transfer using UV exposure. (c) A sacrificial layer of photoresist is fabricated on the substrate. (d) A thin film of ITO is deposited on the sample by sputtering. (e) Lift-off: the unwanted area is removed by Acetone. (f) The cross-section view of the fabricated ITO strips.

Fig. S1 describes the fabrication procedures of the lift-off process. At the beginning,

the glass substrate is cleaned using ultrasonic (by Acetone, isopropyl alcohol and distilled water). After that, the sample is dried by compressed nitrogen and put on the hotplate at 120°C for twenty minutes. Then, an AZ5214 photoresist thin film (thickness = 2 μm) is coated on the substrate by spin coating, see Fig. S1a. Before UV exposure, the sample is put on a hotplate and keep at 100 °C for three minutes to dry the photoresist. Then, the sample experiences 10 seconds UV exposure, which transfers the pattern of the mask to the photoresist layer (Fig. S1b). The UV exposure is conducted using the Suss MA6 mask aligner. As AZ5214 is a positive photoresist, the UV exposure changes the chemical property of the photoresist and makes it soluble in the developer. To remove the unwanted section, the sample is put into AZ300K developer for 15 seconds and then flushed by DI water. The patterned sample is put on the hotplate at 120°C again to get it dried. As shown in Fig. S1c, a layer of the AZ5214 photoresist pattern is left on the substrate. Therefore, only the unpatterned area is exposed to air, making the deposited material get direct contact to the substrate. Before the film deposition, the sample is cleaned by the Oxygen Plasma, which further removes the residual thin film of the photoresist in the exposure area. The ITO film is deposited on the sample by sputtering, see Fig. S1d. In the lift-off process, the sample is put into the Acetone for 30 minutes, the sacrificial layer is dissolved by Acetone, removing target material in the unwanted area. Fig. S1f shows the result of the lift-off procedure: two ITO strips are fabricated on the glass substrate.

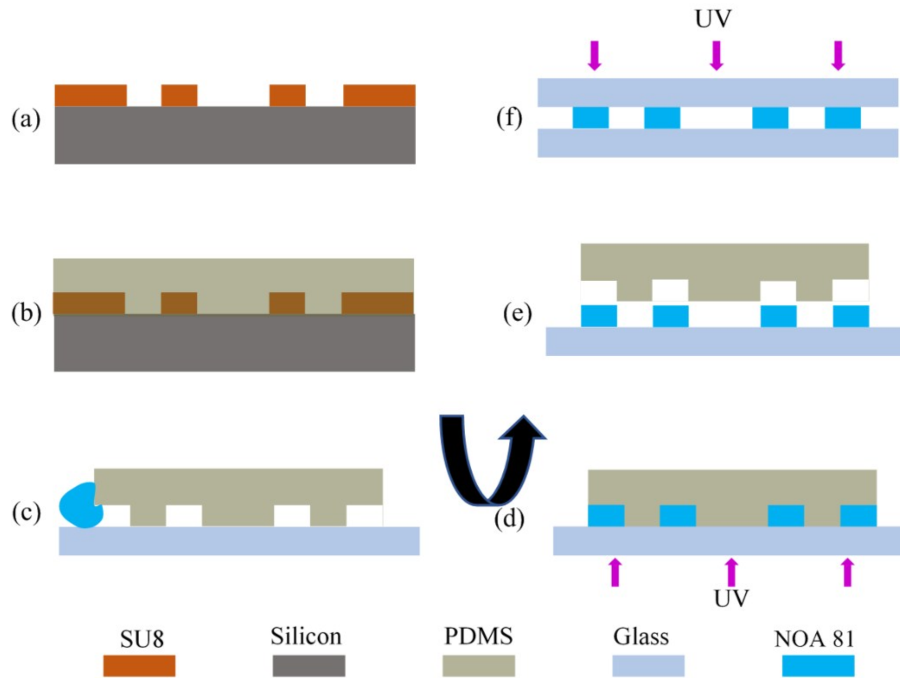

Fig. S2 Sketch of the capillary filling assisted microchip fabrication process. (a) SU-8 50 mold on Silicon wafer. (b) PDMS pattern replicated from the SU-8 50 master. (c) Put the PDMS into contact with a glass substrate and fill the channel with NOA 81 by capillary flow. (d) Partially cure the NOA 81 by UV exposure. (e) Peel the PDMS away and leave the NOA 81 pattern on the substrate. (f) Put the cover on the NOA 81 spacer and bond them together by UV exposure.

In this work, a PDMS assisted capillary filling method is used to fabricate the microfluidic chip. Fig. S2 shows the schematic process of the microchip fabrication using the NOA81 as the intermedia to bond the two glasses together. As shown in Fig. S2a, a SU-8 50 mold (thickness = 60 μm) is fabricated on Silicon wafer using conventional photolithography technique. In step two, the mold is used to construct a PDMS pattern (Fig. S2b), which will be used to transfer the pattern to NOA 81 adhesive later. Peel the patterned PDMS away from the Silicon wafer and put it into contact with glass substrate, as shown in Fig. S2c. The PDMS is attached to the substrate, forming a micro channel for capillary flow. When a drop of NOA 81 adhesive is placed at the end of the channel, the capillary fore drives the adhesive to fill the open channel between the PDMS and glass (see Fig. S2d). Then, UV exposure (2 minutes) is applied

to partially cure the NOA 81. As the PDMS is permeable to air and oxygen inhibits the free-radical polymerization of liquid NOA81, there will be a thin layer of uncured NOA 81 near the PDMS surface. After that, the PDMS is peeled away gently, leaving the NOA 81 pattern layer on the bottom, see Fig. S2e. At last, a glass cover is put on the NOA 81 pattern and press gently to get good contact. Subsequently, UV exposure (2 minutes) is used to fully cure the active NOA 81 and bond the two glasses together firmly (see Fig. S2f). By far, a microfluidic chip make of glasses has been fabricated.