Electronic Supplementary Material (ESI) for Lab on a Chip.

Supplementary Information

Dynamic pneumatic rail enabled microdroplet manipulation

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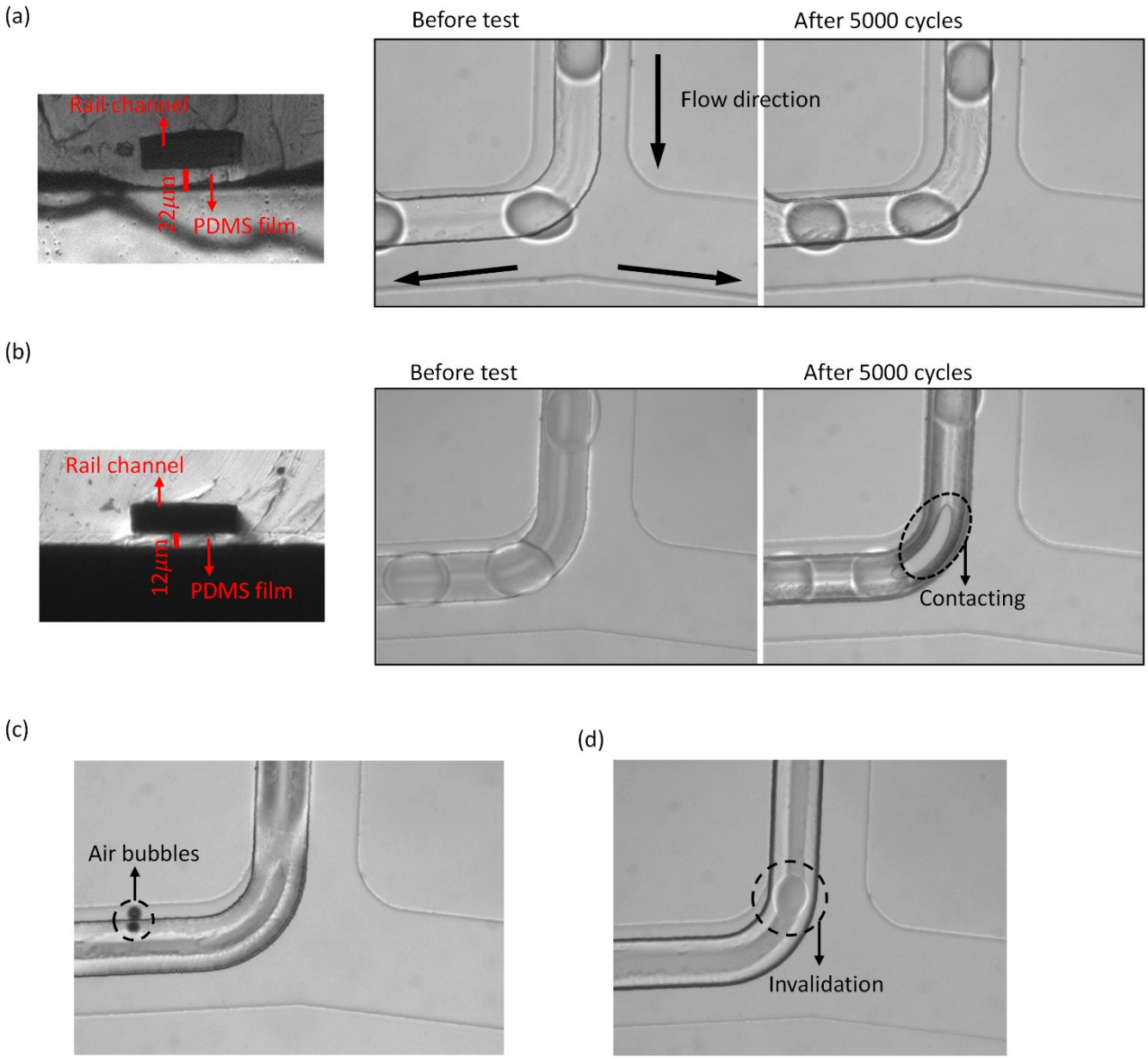

Fig.S1. Fatigue experiment results of 22μm thick and 12μm thick PDMS film: (a) optical photo of 22μm thick PDMS film, and the performance of sorting droplets was stable after 5000 cycles; (b) optical photo of 12μm thick PDMS film, and after 5000 cycles, the performance of sorting droplets was stable, except that the deformation of the film increased and made the film contact with the bottom of the rail channel; For 12μm thick PDMS film, air bubbles overflowed from the rail channel to the droplet channel through the film when the film bent from upward to downward(c), and the film lost flexibility and failed to bend after 5000 cycles (d).

Fatigue experiments were carried out to demonstrate whether the performance of sorting droplets would change after repeatable bending upward and downward. During the experiments, the pressure of the oil and water was 500$mbar$ and 398$mbar$, separately. The air pressure in the rail channel changed circularly between 0Pa and 0.2MPa with an interval of 0.5s. When the air pressure was 0Pa, the film sagged downward due to P_{oil}, and When the air pressure was 0.2MPa, the film protruded upward due to P_{air}. We took 1000 cycles as a period, and each film was tested for 5 periods. In this section, the width of the rail channel was 100μm.

As shown in Fig S1(a), the experiment results demonstrated that for 22μm thick film, after 5000 cycles, the performance of sorting droplets by the film was still stable. The film maintained well without any damage, except that the number of cracks in the film increased. Compared to 22μm thick film, the deformation of the 12μm thick film is greater under the same P_{oil}. For 12μm thick

film, because the film was too thin, air bubbles overflowed from the rail channel to the droplet channel through the film, as shown in Fig S1(c). After 5000 cycles, it was obvious that the film became easier to take deform. At the bent, the film sagged downward to contact the bottom of the rail channel. Moreover, when all the pressure decreased to zero, the film lost flexibility and failed to restored to its original state, as shown in Fig S1(d). The invalidation would reduce the life of the film after long-term manipulation.