Supporting Information

Ultrasonic assisted bonding method for heterogeneous microstructures using self-balancing jig

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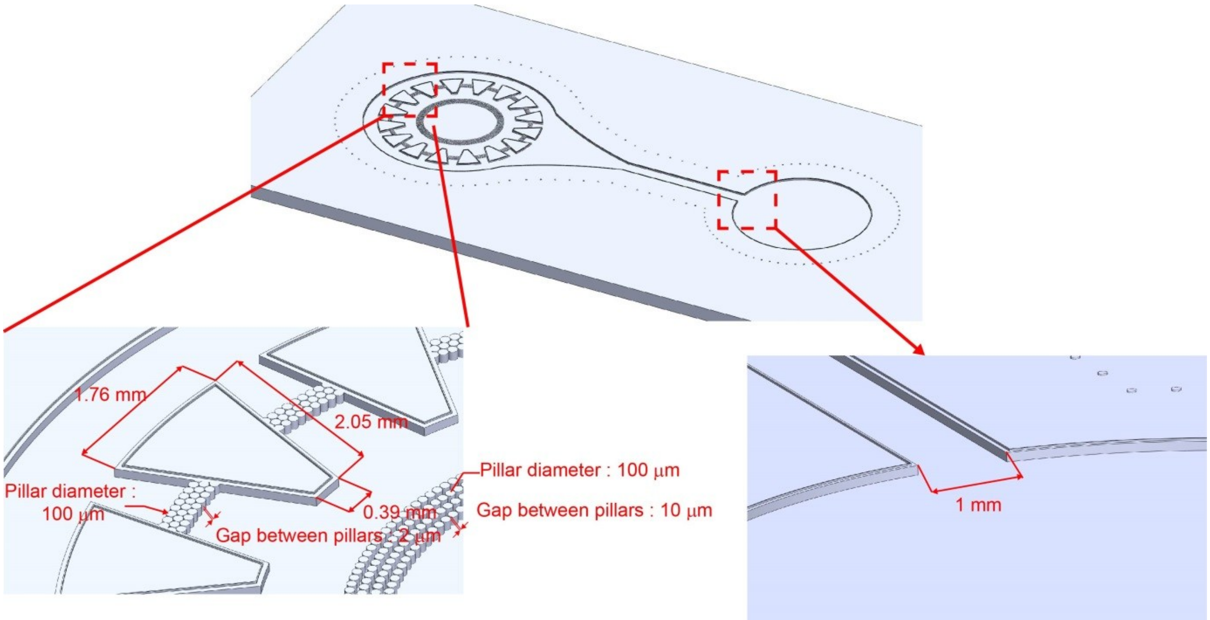

Fig. S1. Schematic illustration of the device and its dimensions.

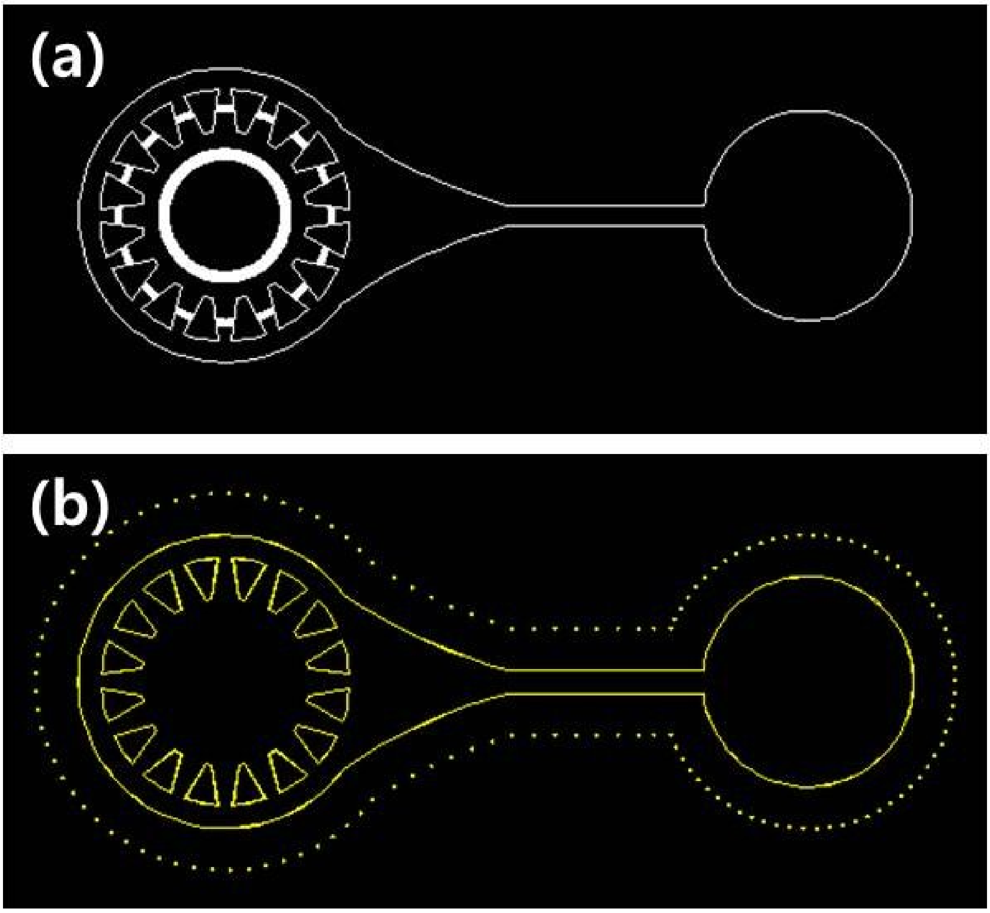

Fig. S2. Blueprint of microfluidic devices by drawing with aid of computer-aided design (CAD) and its (a) major structures and (b) welding lines.

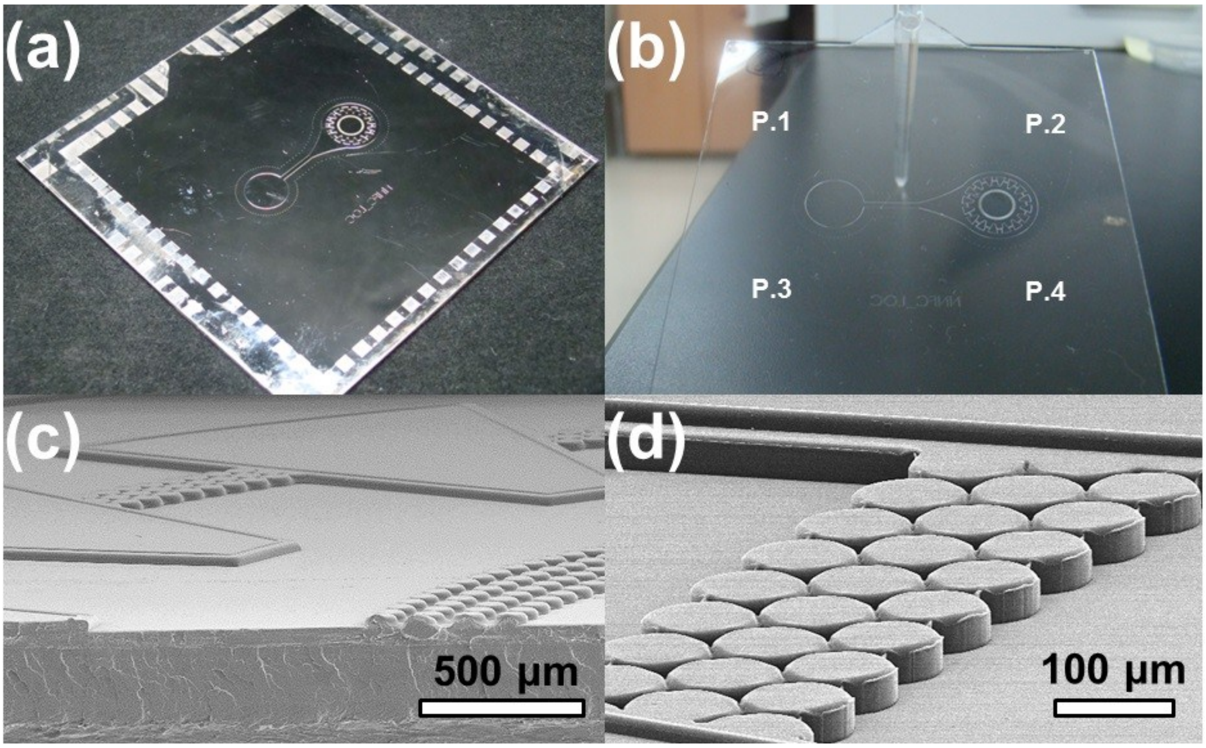

Fig. S3. Photographic images of (a) the Ni stamp and (b) the COC device. (c and d) SEM images of pillar arrays, welding lines and isosceles trapezoid structures replicated over COC surface.

Table S1. Thickness measurements of the COC device in each corner.

	Point 1 (P.1)	Point 2 (P.2)	Point 3 (P.3)	Point 4 (P.4)	Average differences
Thickness (mm)	1.01	1.02	1.03	0.99	0.02

The average thickness difference is about 1.68% which is in the normal range of shrinkage of polymers.

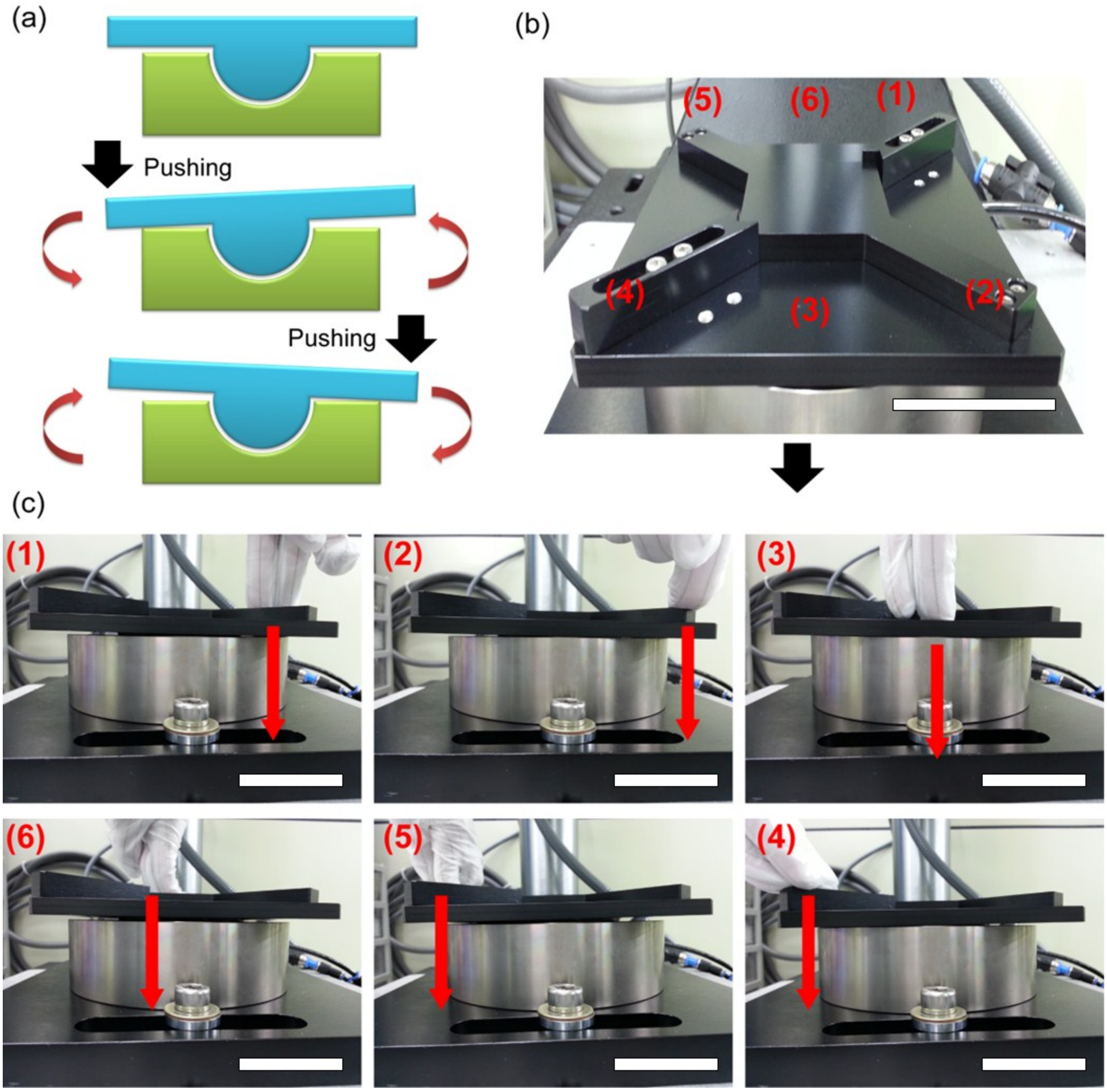

Fig. S4. (a) Schematic illustration for the movement of top-plate along with applied external forces. (b) Photographic image of the self-balancing jig from top view. (c) The photographic images from different movement scenarios of the top plate which are corresponded to the external forces. Each numbers from (b) is matched to the images from (c) after pressing the plate by human fingers. All scale bars are 50 mm.

The schematic illustration and photographic image (Fig. S4) demonstrated the working principle behind of the self-balancing jig. The hemispherical-shape of the jig as shown in Fig. 2c presented a round shape and it smoothly moves to correspond from external forces.

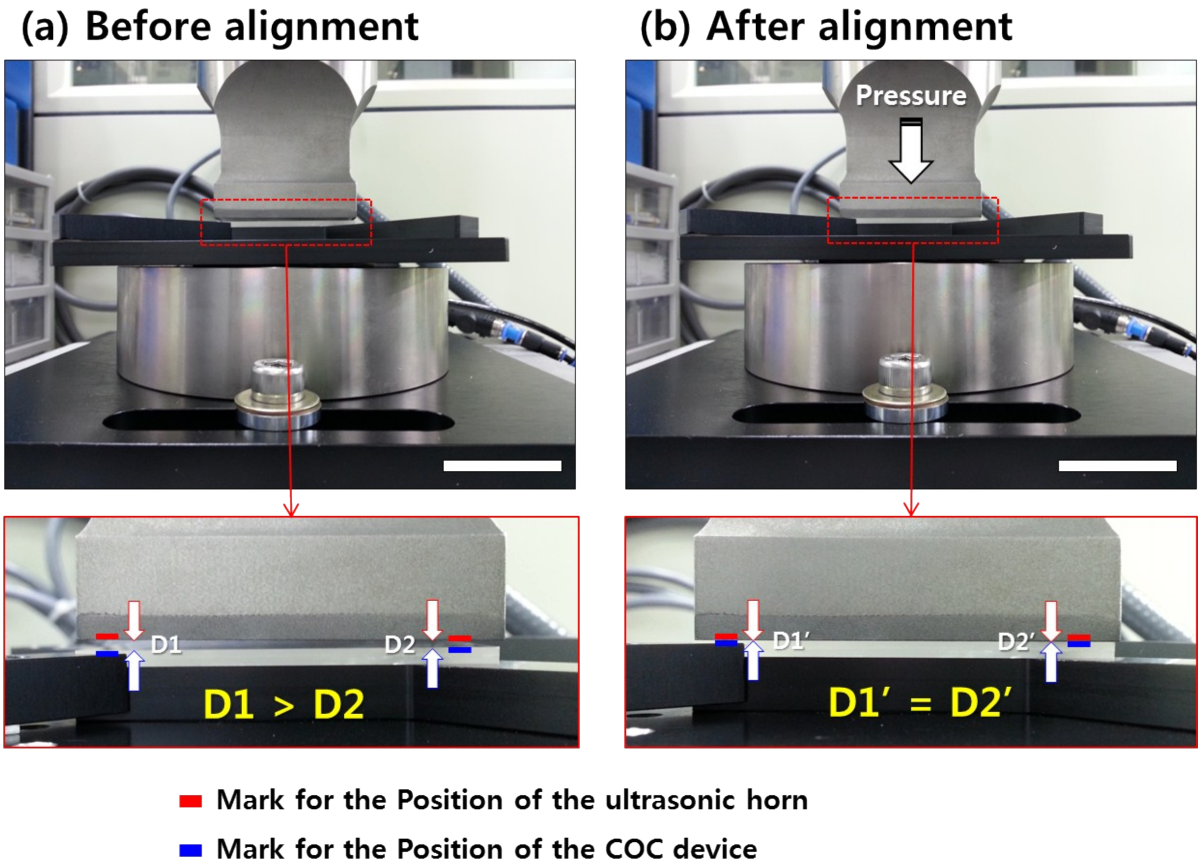

Fig. S5. Photographic images of (a) before alignment and (b) after alignment of the device using the self-balancing jig. The misalignment of top plate of jig was perfectly balanced as pressing the horn to both device and jig. All scale bars are 50 mm.

Before the ultrasonic bonding, the top plate was initially unbalanced in any position due to free movement of the jig. However, after loading ultrasonic horn, both the device and the horn were directly contacted and aligned in all the direction (Fig. S5).

For the further demonstration of the working principles, we also provided supplementary movie (Mov S1) which explain how the jig working under different scenarios of bonding.