Supplementary Information (SI)

Cyclic olefin copolymer as an X-Ray compatible material for microfluidic devices

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Device Fabrication (Figure S1)

In this section, we present more details on our device fabrication method. Fig. S1 (following page) is an extension of Fig. 1 in the main text. All steps, starting from the silicon-wafer with channel structure all the way to the finished device, are shown.

Figure S1 Device Fabrication steps (see following page) (a) The channel structures (black) are defined by photolithography using SU8-2150 negative photo resist spin coated on Si-wafers to a final height of 160 μm. (b) PDMS copies (blue) of the channel structures are produced. PDMS and cross-linker are mixed at a ratio of 10:1 and poured onto the structured Si-wafers. After evacuating the PDMS for 20 min to remove all air bubbles, it is cured by backing for 1 h at 65 °C. (c) A 1 mm thick glass slide (gray) is prepared with UV-curable adhesive (yellow) and all air bubbles are removed with a needle. (d) The PDMS stamp is pressed into the adhesive and cured with UV-light (λ = 366 nm) for three minutes. (e) After detaching the PDMS stamp from the glass slide and removing residual structures with a scalpel, the UV-curable adhesive is cured again for three minutes. (f) The stamp (yellow) and a COC sheet (green) are sandwiched between two sheets of paper, followed by two sheets of aluminum foil. This assembly is heated above the glass transition temperature of the COC (130 °C) for 5 minutes, with the help of a hot press. It is then pressed with initially 2.2 kN for 10 minutes. Thus, the structured UV-cured adhesive is transferred into the COC layer. (g) After cooling down the hot press, the stamp is removed from the COC after wetting with 2-propanol, which flows between the two layers because of capillary forces. The adhesive stamp can be reused. (h) Holes for the inlet and outlet are punched with a biopsy puncher (diameter 0.5 mm). (i) A 20 μm thick COC sealing layer and the channel structure in COC are sandwiched in paper and placed in a lamination machine with heat and pressure control. The device is sealed at a temperature of 100 °C and a speed of 7.6×10^{-3} m/s. (j) The finished COC device contains channels with a width of 200 μm, a height of 160 μm and a total thickness of 70 μm COC within the beam path.

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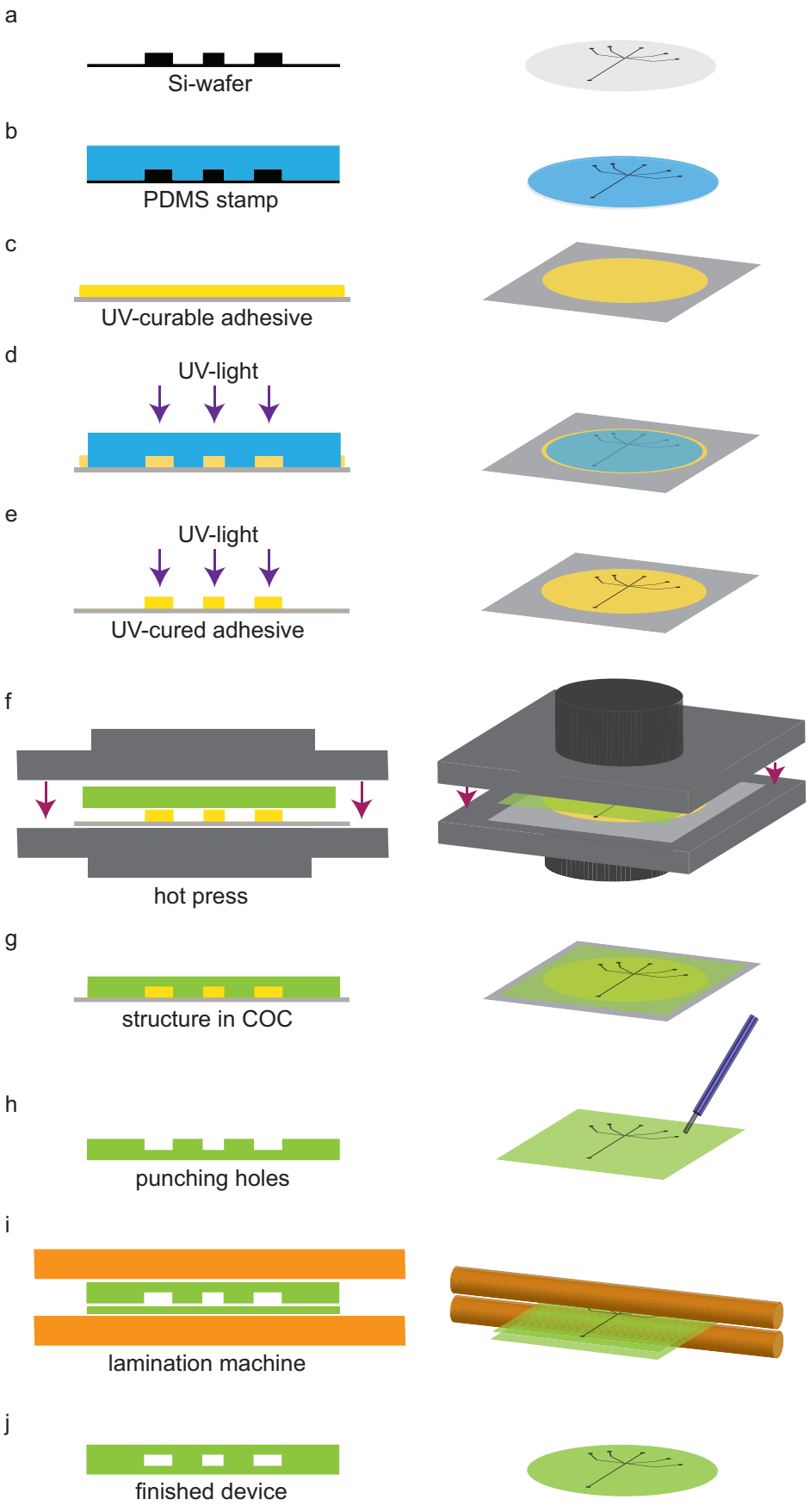
a
Si-wafer
b
PDMS stamp
c
UV-curable adhesive
d
UV-light
e
UV-light
UV-cured adhesive
f
hot press
g
structure in COC
h
punching holes
i
lamination machine
j
finished device

Cross Section of the Channel Structure (Figure S2)

The cross sectional view of a typical device is depicted in Figure S2. Due to the challenge in cutting the device precisely without squeezing the channels the edges appear blurry and the bottom of the device is slightly stretched. However, the well-defined channel structure with straight walls is clearly visible.

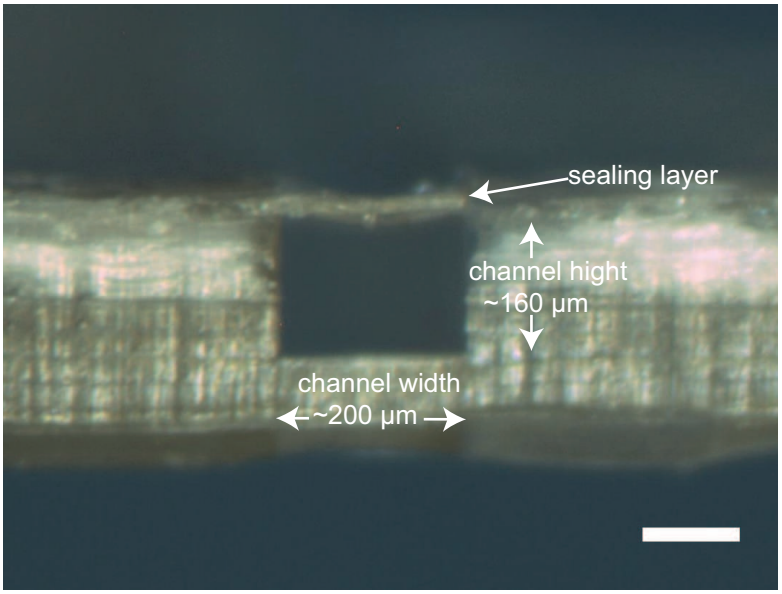

Figure S2 Side view of a typical COC device. The channel height is ∼160 μm and the channel width ∼200 μm. The scale bar corresponds to 100 μm.

Sample Holder (Figure S3)

In the following the used sample holder is described and shown in detail.

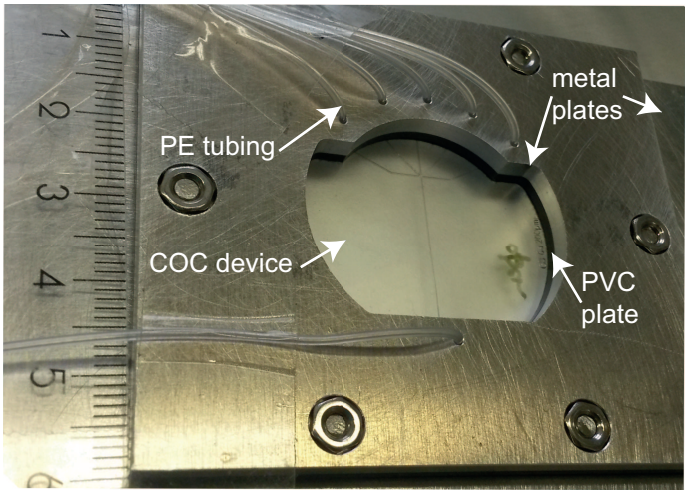

Figure S3 The sample holder consists of two metal plates with different sizes. The metal back plate is larger to allow for mounting to the setup. The upper metal plate contains openings for the tubing. Both plates contain an opening to perform measurements inside the COC device. Sandwiched between the upper metal plate and the COC device is a PVC plate that contains holes for the tubing and indentations for o-rings. The o-rings get compressed by tightening six screws and therefore seal the connection between the device and the tubing. The scale shown is in cm.