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

Supplementary Information

Inkjet printing of UV-curable adhesive and dielectric inks for microfluidic devices

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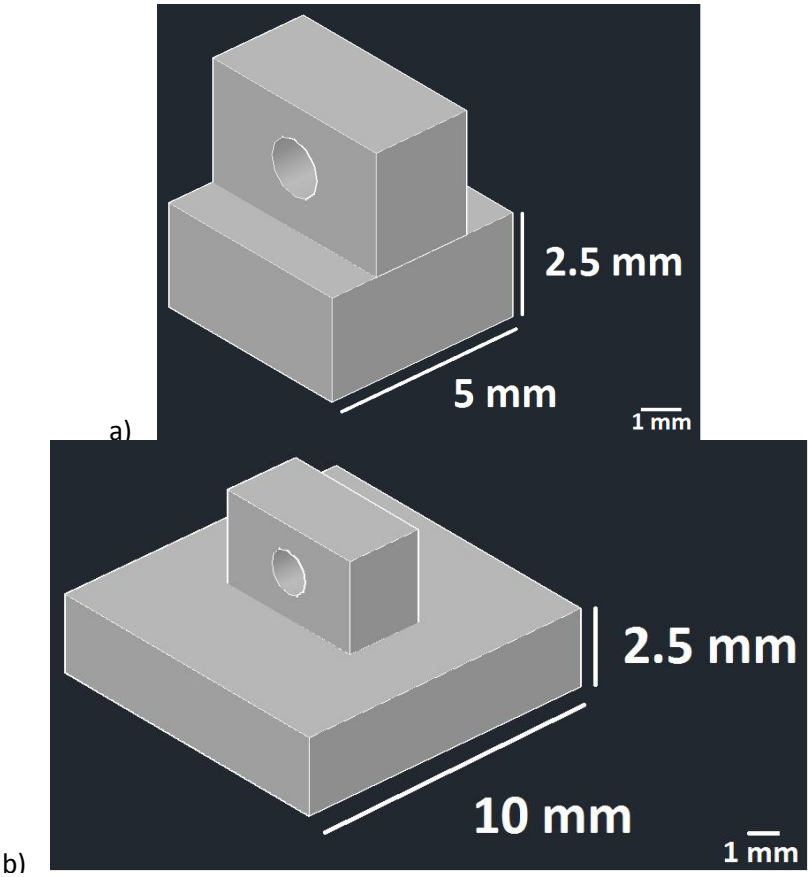
Fabrication of 3D test bodies

All samples were designed in AUTOCAD 2013 (Autodesk Inc., USA) and converted into STL files. This structures were sliced in 2D layers using the Miicraft 3D-printer software, generating Portable Network Graphic images (PNG). Samples were printed with 50 µm layer thickness using UV acrylate Clear Resin BV-003 (Young Optics Inc., Hsinchu, Taiwan).

The dimensions of the 3D-printed samples were 2.5 x 5 x 5 mm^3 and 2.5 x 10 x 10 mm^3 (H x W x L) with support on the top for connecting the weights for the bonding strength measurement (see Fig. S1). After printing, the samples were washed with ethanol to remove uncured resin, dried with nitrogen, and post-cured using a printer-integrated UV-Lamp (18W UVA Lamp).



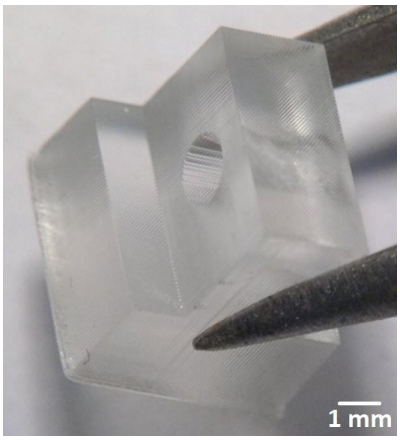
c) 

Fig. S1. The CAD design of samples with different dimensions a) 2.5 x 5 x 5 mm^3; b) 2.5 x 10 x 10 mm^3 (H x W x L) with support on the top for connecting the weights for the bonding strength measurement; c) real picture of the 3D-printed sample a).

Fabrication of the bonding strength measurement system

Homemade bonding strength (see Fig. S2) and bursting pressure (see Fig. S3) measurement systems were built to evaluate, respectively, the bonding and sealing quality between the 3D-printed sample and the substrate bonded with the UV-cured ink. Standard weights were gradually added to the system until the 3D-printed structure detached from the substrate. A bursting pressure test system was also prepared using a 3D-printed block and PQA1M substrate cover. For comparison with bonding strength experiments, the test device was designed to have the same contact area as the test bodies used in the bonding strength experiments, namely 25 mm^2, albeit with a circular rather than rectangular geometry. To test the sealing quality of UV-cured adhesive, the outlet of the 3D-printed test block was connected to a compressed air source. The readings of an analog pressure gauge were used to quantitatively read out the bursting pressure (see Fig. S4).

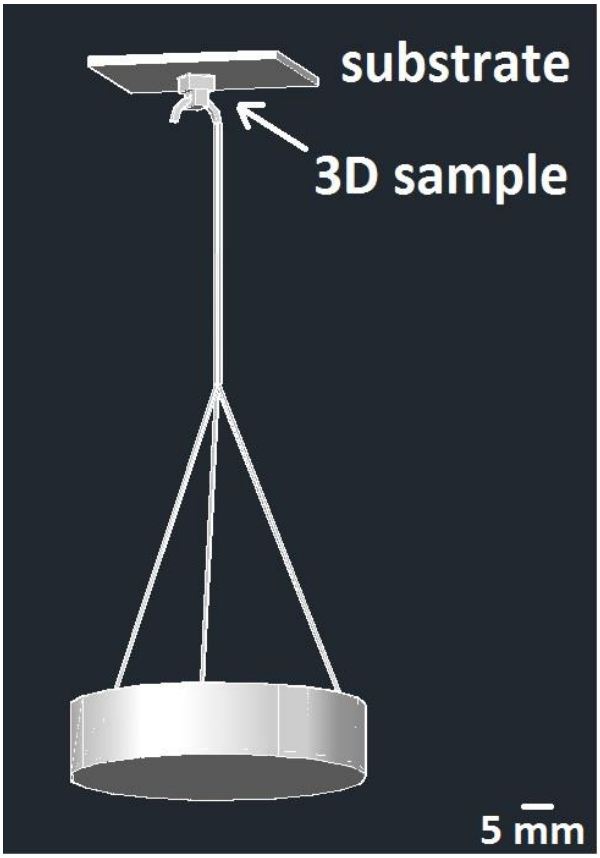


Fig. S2. The CAD design of the homemade bonding strength measurement system.

Bursting pressure measurements

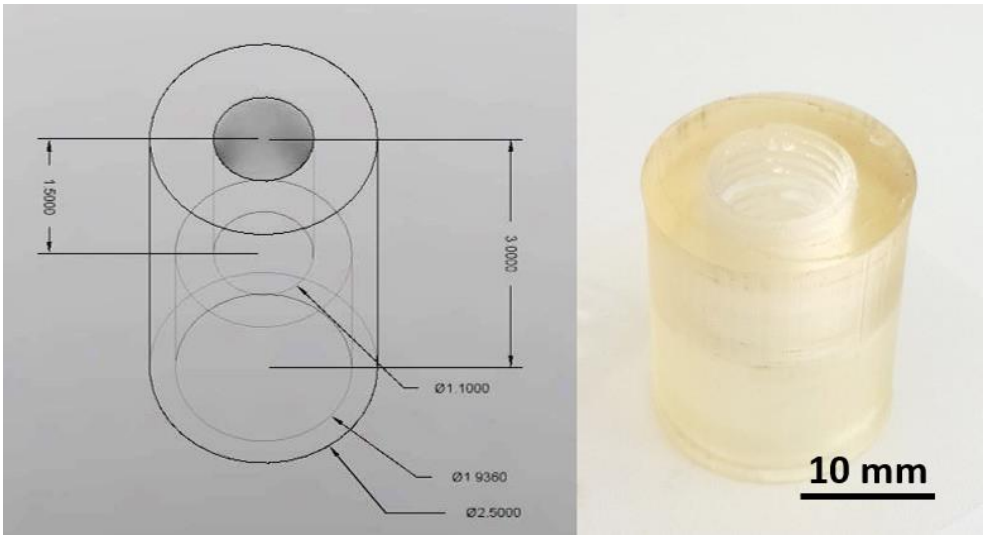


Fig. S3. CAD design of a bursting pressure test device (left) and a 3D-printed implementation of this design with a contact area of 25mm^2 (right)

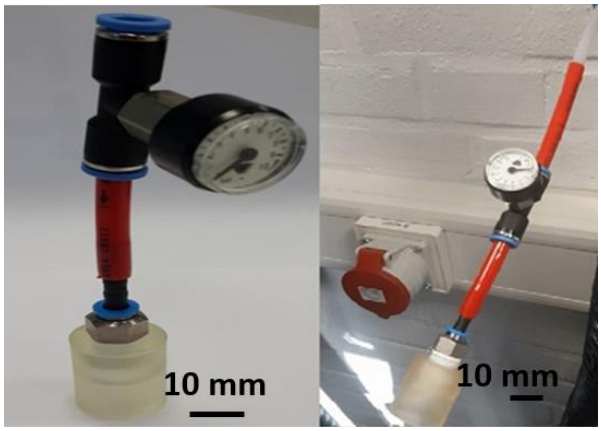


Fig. S4. Bursting pressure measurement was carried out using compressed air via a pressure gauge.

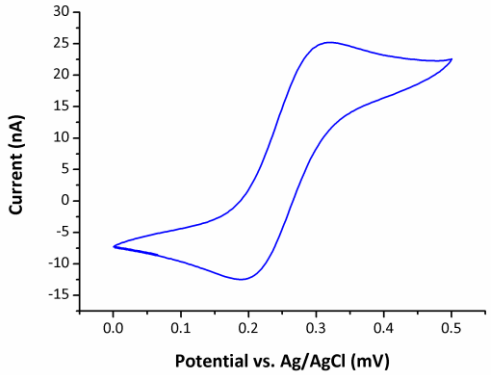


Fig. S5. Cyclic voltammogram obtained for a test electrode passivated by printed PVP-co-PMMA ink. The electrode potential was swept from 0 V to 0.5 V at a scan rate of 100 mV s^{-1} using 500 μM ferrocene dimethanol as a redox-active probe.

Cyclic voltammogram (CV) measurements of the test electrode were done by applying a potential between 0 V and 0.5 V versus the Ag/AgCl reference electrode (Super Dri-ref SDR 2, World Precision Instruments) at a scan rate of 100 mV/s. 500 μM 1,1-ferrocene dimethanol, (Sigma-Aldrich) prepared in PBS solution (pH 7.4) was used as a redox probe to investigate the electrode behavior.

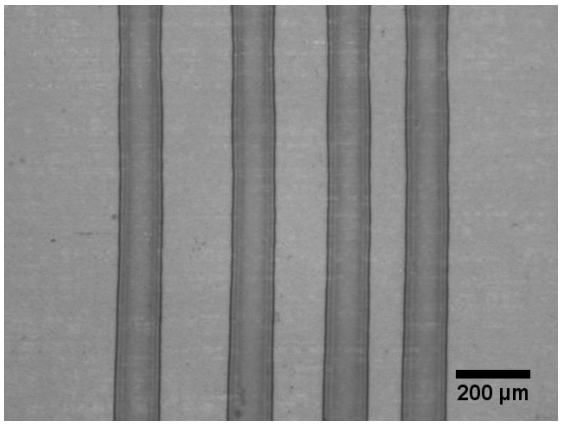


Fig. S6. Inkjet-printed lines using PVP-co-PMMA ink printed on a Q83 substrate with different line-to-line spacing. The spacing between lines, from right to left, corresponds to 180, 150, and 100 µm, respectively.