Supplementary Information (SI) for Lab on a Chip.

Supplementary Information: *Bridging dimensions: Combining one- and two-photon 3D printing for microfluidic device fabrication*

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S1 Design Details

After 1PP (one photon polymerization) channel resolution target characterization (**Figure S1**), the 1PP manifold (**Figure S2**), 1PP adapter (**Figure S3**), and 2PP (two photon polymerization) chip (**Figure S4**) were optimized for seamless integration.

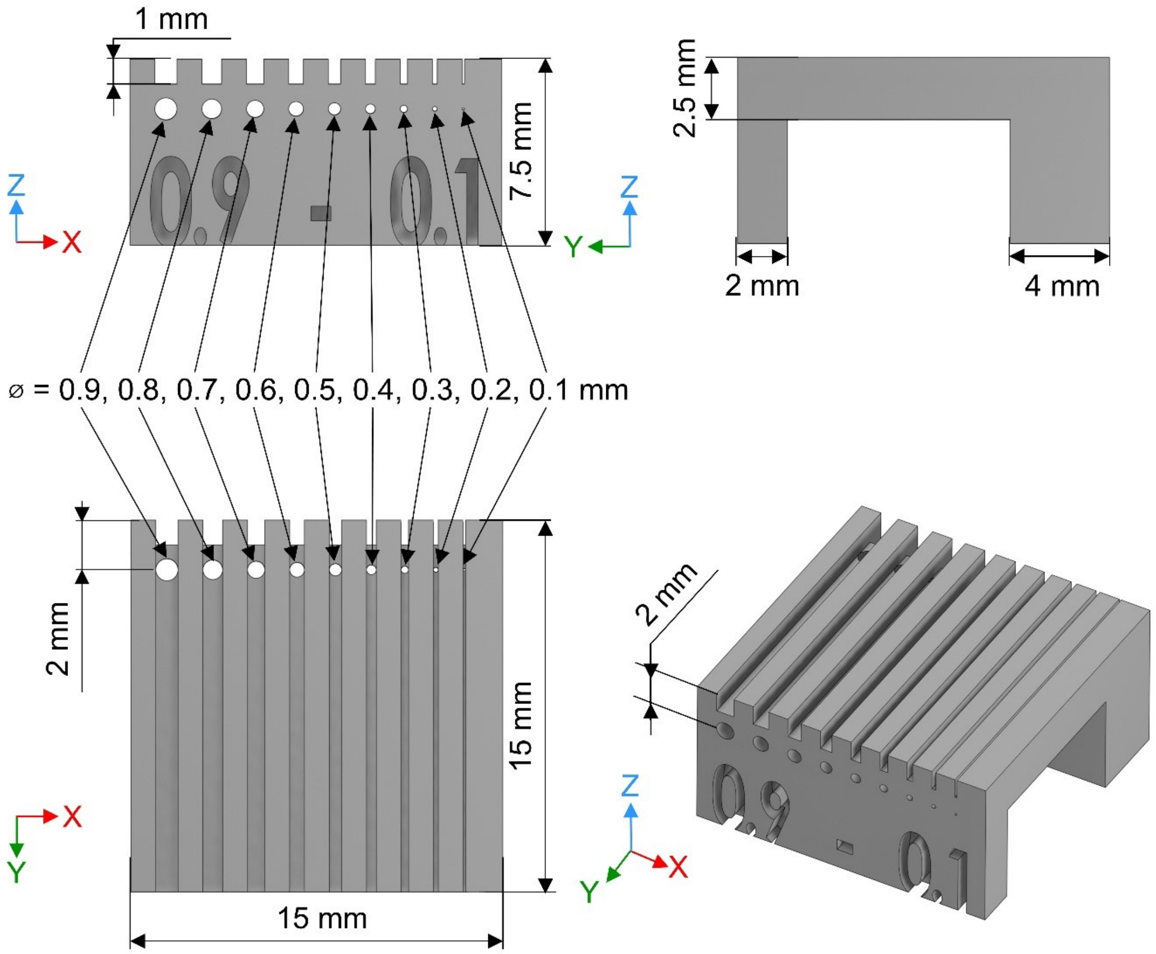

Figure S1: Dimensions of the 1PP channel resolution target to identify smallest reliable microchannel diameter by SLA.

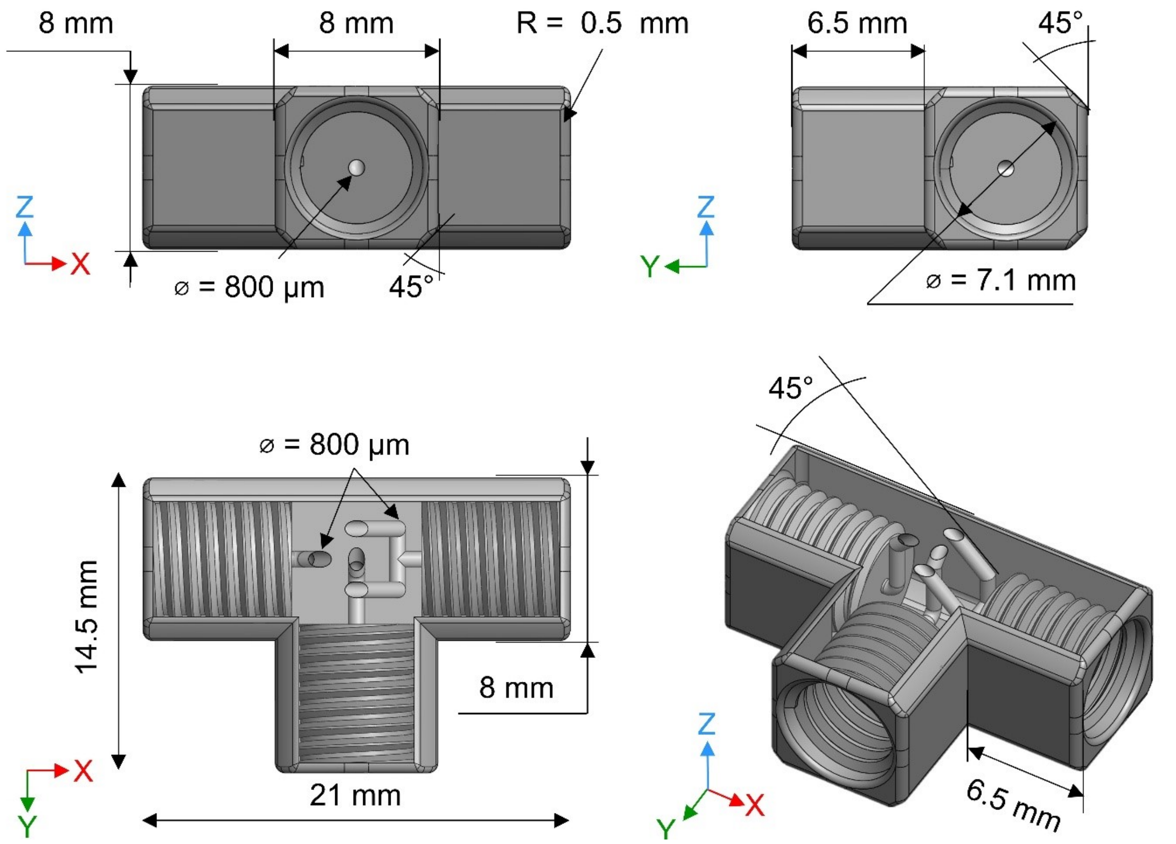

Figure S2: Dimensions of the 1PP manifold. Threads were modeled to receive right-handed 1/4-28 UNF fluid connectors. The thread depth is 9.25 mm. All interface channels to the 2PP chip egress the manifold at a 45° angle.

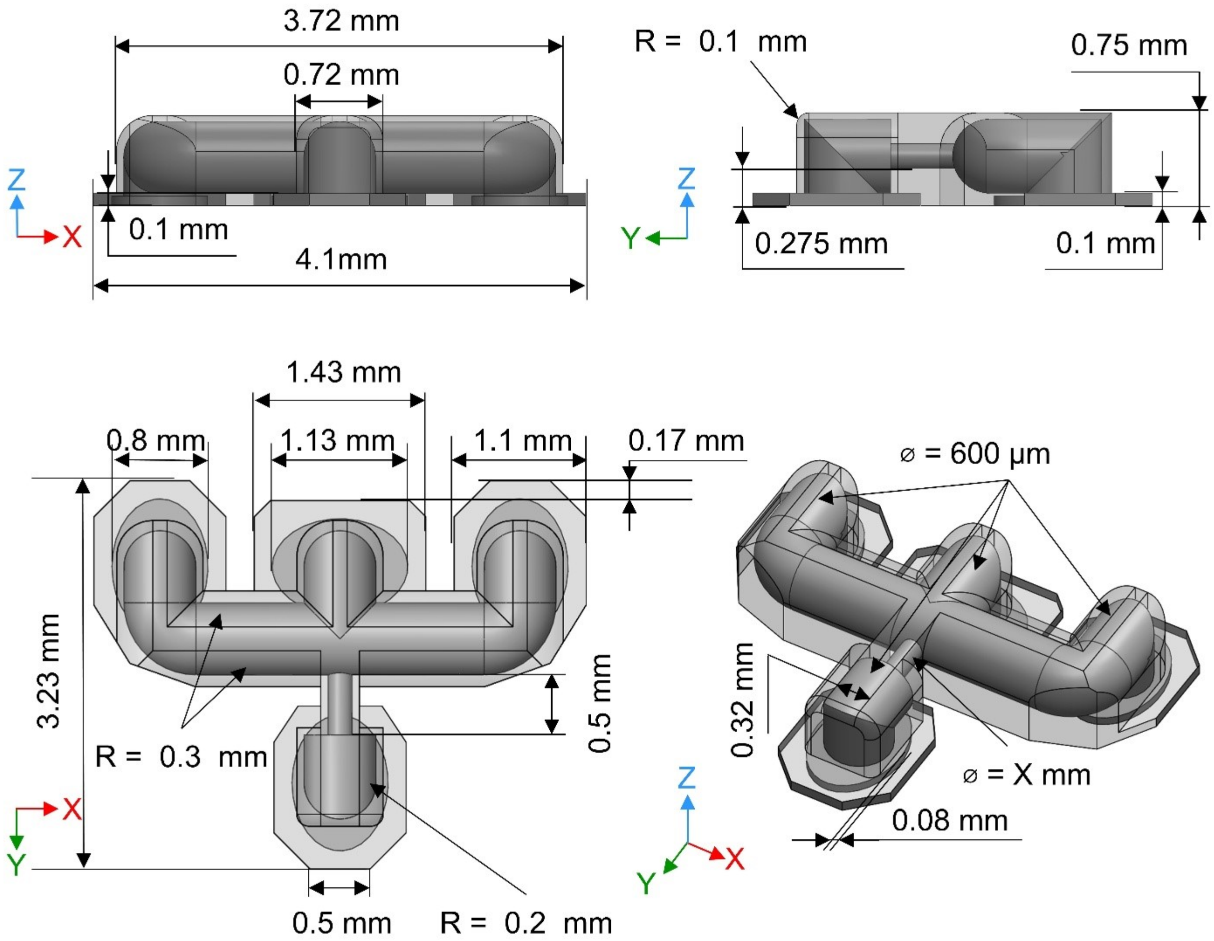

Figure S3: Dimensions of the 2PP chip. Nozzle orifices of X = 250, 350, and 500 µm were designed. Flange thickness includes a design tolerance of ΔZ = 100 µm, while tolerances of ΔX = 300 and ΔY = 170 µm are included in the flange design itself.

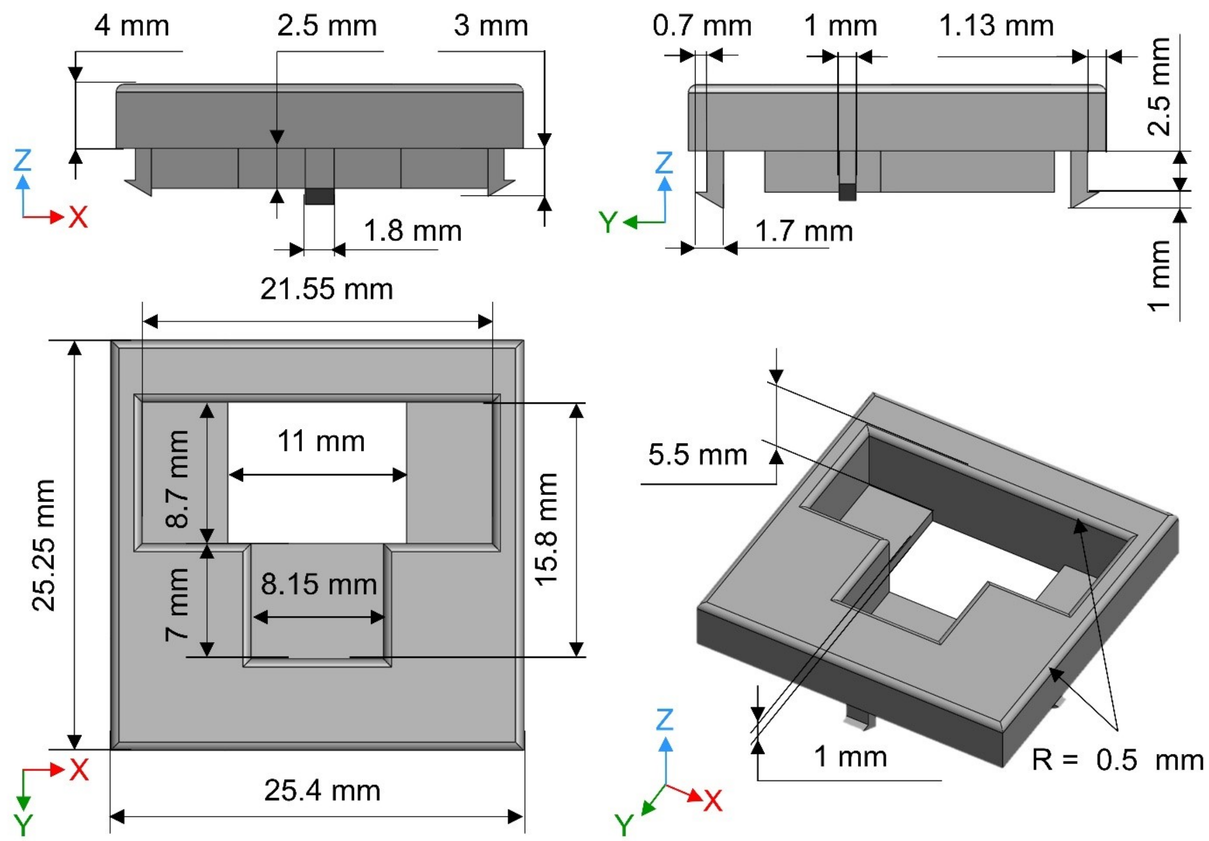

Figure S4: Dimensions of the 1PP adapter. The reusable adapter is secured with a click-fit into the square mounting positions of the 2PP sample holder. Design tolerances were optimized to ensure a snug fit of the 1PP manifold.

S2 1PP Manifold Surface Roughness

The maximum surface height (S_z), the maximum surface peak height (S_p), and maximum surface valley height (S_v) were calculated according to **Equations S1-S3**.

$$S_z = S_p + S_v \qquad \textbf{Eq. S1}$$

$$S_p = \max_A(z_{com}(x, y) - z_{mean}(x, y)) \qquad \textbf{Eq. S2}$$

$$S_v = \left|\min_A(z_{com}(x, y) - z_{mean}(x, y))\right| \qquad \textbf{Eq. S3}$$

The maximum profile height $R_{z,x}$ or $R_{z,y}$, maximum profile peak height $R_{p,x}$ or $R_{p,y}$ and maximum profile valley height $R_{v,x}$ or $R_{v,y}$ were calculated according to **Equations S4-S9**.

$$R_{z,x} = R_{p,x} + R_{v,x} \qquad \textbf{Eq. S4}$$

$$R_{p,x} = \max_y(z_{com}(x, y) - z_{mean}(x, y)) \quad x = \text{const.} \qquad \textbf{Eq. S5}$$

$$R_{v,x} = \left|\min_y(z_{com}(x, y) - z_{mean}(x, y))\right| \quad x = \text{const.} \qquad \textbf{Eq. S6}$$

$$R_{z,y} = R_{p,y} + R_{v,y} \qquad \textbf{Eq. S7}$$

$$R_{p,y} = \max_x(z_{com}(x, y) - z_{mean}(x, y)) \quad y = \text{const.} \qquad \textbf{Eq. S8}$$

$$R_{v,y} = \left|\min_x(z_{com}(x, y) - z_{mean}(x, y))\right| \quad y = \text{const.} \qquad \textbf{Eq. S9}$$

Table S1: Roughness parameters over the whole surface and along cuts at x = 1190.16 µm and y = 2167.14 µm using a 4% cutoff value.

roughness parameter	surface	x = 1190.16 µm	y = 2167.14 µm
arithmetical mean height / µm	S_a = 13	$R_{a,x}$ = 17	$R_{a,y}$ = 10
maximum height / µm	S_z = 123	$R_{z,x}$ = 64	$R_{z,y}$ = 50
maximum peak height / µm	S_p = 55	$R_{p,x}$ = 42	$R_{p,y}$ = 32
maximum valley height / µm	S_v = 68	$R_{v,x}$ = 22	$R_{v,y}$ = 18

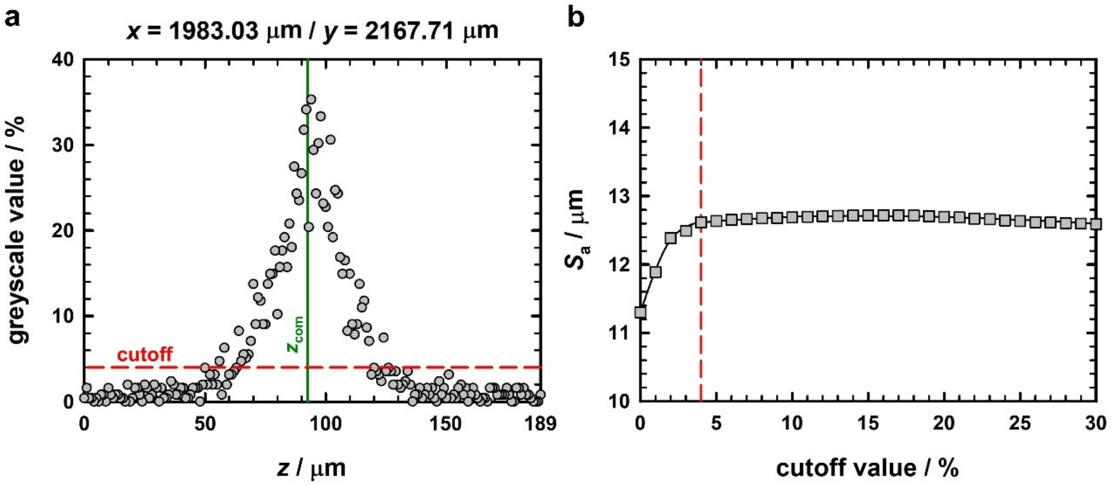

Figure S5: 1PP surface roughness quantification. (**a**) Greyscale values of the pixel at position X = 1983.03 µm and Y = 2167.71 µm plotted as a function of height Z. (**b**) The arithmetical surface mean height S_a plotted as a function of the cutoff value (red dashed line). This cutoff defines the minimum greyscale value required for a pixel to contribute to the surface height z_{com} via a center of mass (green line) quantification. A cut-off value of 4% (red dashed line) was chosen since S_a reaches a plateau of ≈ 13 µm for cutoff values above this threshold.

S3 Manufacturing Workflow

The 1PP manifold and adapter are fabricated by 1PP SLA (**Figure S6**). Both are mounted in the 2PP sample holder (**Figure S7**). A tight fit between the 1PP manifold and adapter is important for bottom-up placement in the 2PP DLW 3D printer (**Figure S7e**). After 2PP chip manufacturing, residual resin is pushed out of the microchannels by connecting a syringe via the 1PP manifold and rinsing with isopropanol and PGMEA. A final UV curing step of the completed device is detailed in **Section 4.4**. In addition, an imaging window was introduced to improve optical transparency (**Figure 5**).

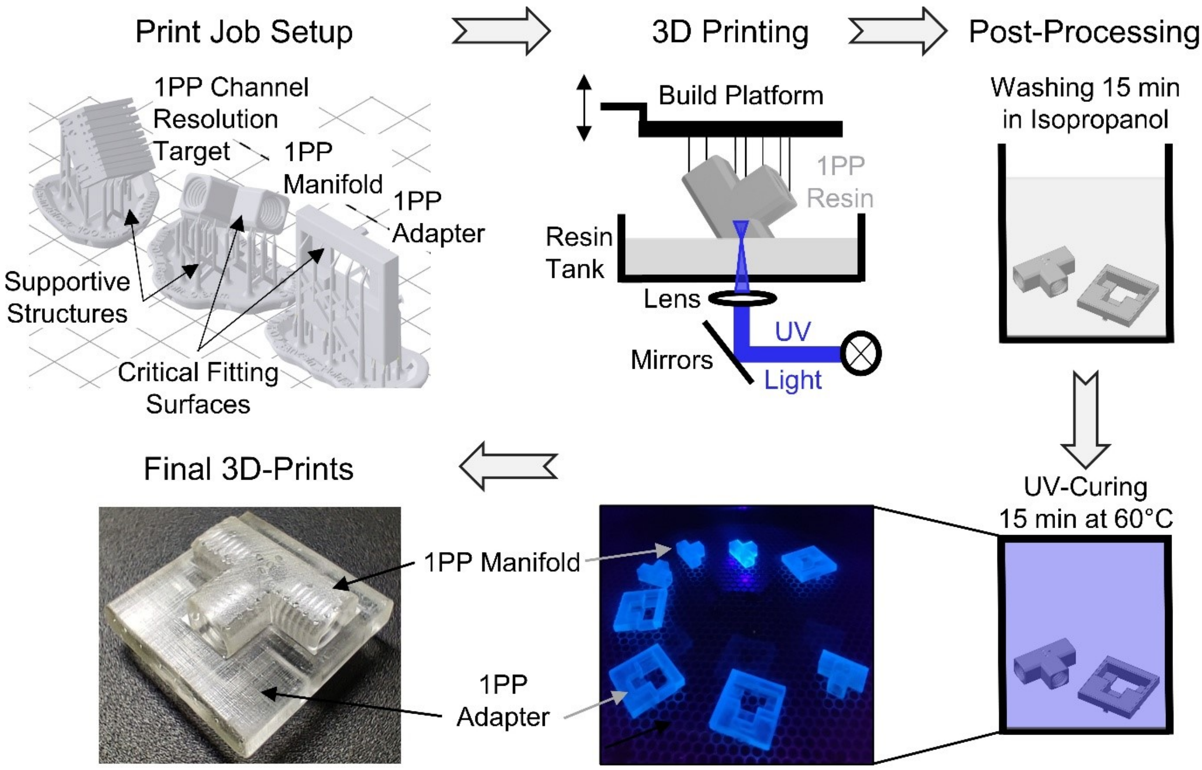

Figure S6: Schematic of the 1PP SLA workflow. After print job configuration, the part was printed. Post-processing includes washing off uncured resin, followed by blow-drying using pressurized air. Once all residual resin was removed, parts were UV-cured for 15 min at 60 °C. Supports were subsequently removed, and the parts can be used without further modification.

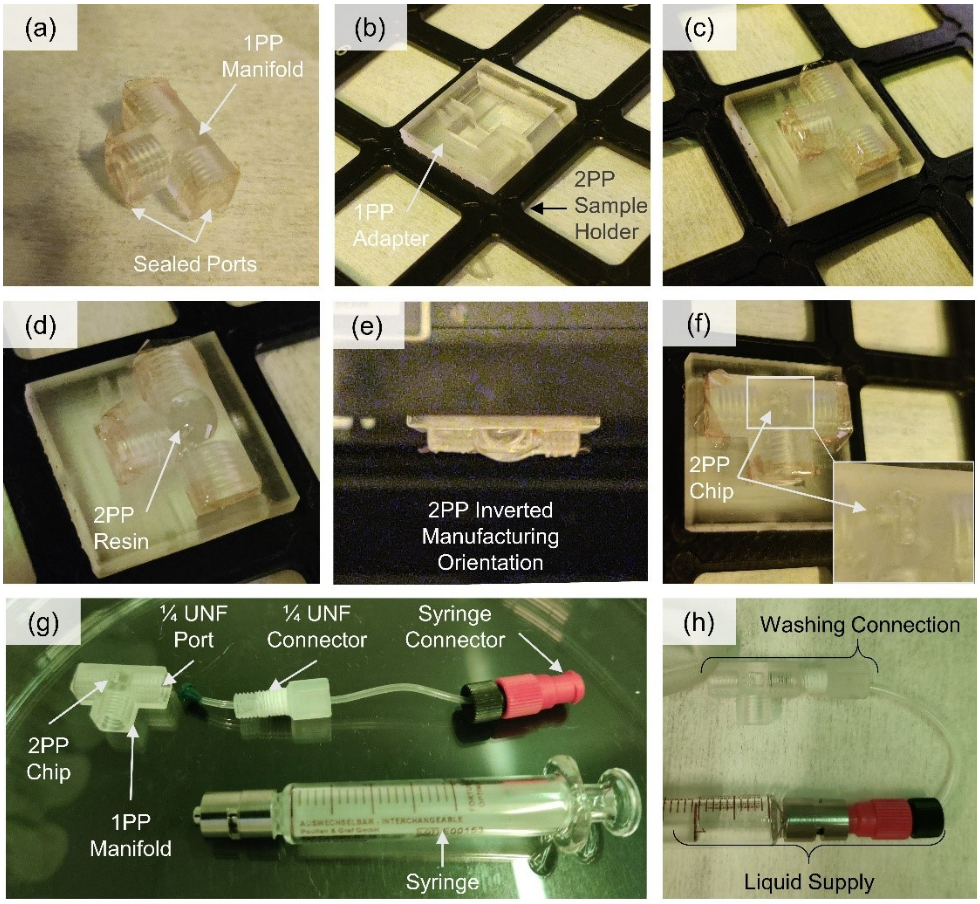

Figure S7: Ex situ 2PP chip fabrication workflow. (**a**) 1PP manifold ports are sealed with polyimide adhesive tape. (**b**) The 1PP adapter is clipped into the 2PP sample holder (black). (**c**) The sealed 1PP manifold is pushed into the 1PP adapter. (**d**) IP-S is placed atop the 1PP manifold to cover the interfacing microchannels (arrow). (**e**) The 2PP sample holder is placed upside down in the 2PP-3D printer, and the print job is started. (**f**) 1PP manifold with 2PP chip fabricated on top (arrow). (**g-h**) Microfluidic channels are washed by connecting a syringe to the 1PP manifold and gently flushing with PGMEA, isopropanol, and air.

S4 Microfluidic Bubble Generation Setup

Reproducible bubble production is shown in **Video S1**, while **Figure S8** illustrates how the microfluidic device is connected to the gas and liquid supply

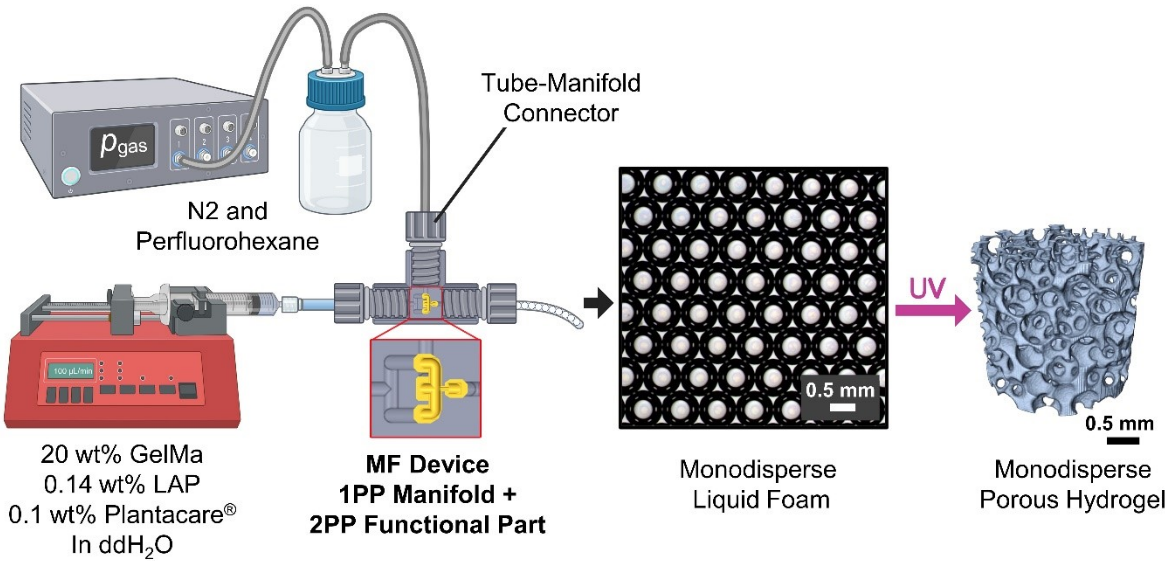

Figure S8: Schematic of the microfluidic bubble generation setup. Tubing connects a syringe pump to the 1PP manifold inlet port to deliver the continuous liquid phase. The dispersed gaseous phase is also connected to the 1PP manifold and is delivered by a pressure controller. Bubble formation proceeds inside the 2PP chip orifice, resulting in a monodisperse foam, which is collected and then crosslinked by UV light to yield a solid porous hydrogel.