Electronic Supplementary Information (ESI):

**Inkjet print microchannels based on liquid template**

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S 1. Preparation of printable ink

To control the morphology stability of the liquid template, undecanol is used as the main component of the ink due to its temperature-controllable viscosity. However, the undecanol is unprintable at room temperature (22 ℃) due to its high viscosity (15.2 mPa·S). To make the undecanol printable at room temperature, ethyl lactate is added into the ink to decrease the viscosity of undecanol (9.8 mPa·S) in the mass fraction of 1/4. The rheology properties of undecanol and the ink containing undecanol and ethyl lactate are shown in Fig. S1. The viscosity of undecanol is sensitive to temperature in the range of 20 ℃ to 10 ℃. And the viscosity of the ink containing undecanol and ethyl lactate is sensitive to temperature in the range of 20 ℃ to about 3 ℃.

![Rheology properties of undecanol and ink containing ethyl lactate.](image)

**Table S1** Density of the ink and PDMS prepolymer mixture

<table>
<thead>
<tr>
<th></th>
<th>Test time</th>
<th>Weight/g</th>
<th>Volume/ml</th>
<th>Density/g ± ml(^-1)</th>
<th>Average density/g ± ml(^-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ink</strong></td>
<td>1#</td>
<td>6.023</td>
<td>7</td>
<td>0.860</td>
<td>0.86</td>
</tr>
<tr>
<td></td>
<td>2#</td>
<td>6.911</td>
<td>8</td>
<td>0.864</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3#</td>
<td>8.628</td>
<td>10</td>
<td>0.863</td>
<td></td>
</tr>
<tr>
<td><strong>Prepolymer</strong></td>
<td>1#</td>
<td>5.189</td>
<td>5.1</td>
<td>1.017</td>
<td>1.04</td>
</tr>
<tr>
<td><strong>mixture</strong></td>
<td>2#</td>
<td>7.614</td>
<td>7.2</td>
<td>1.058</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3#</td>
<td>5.710</td>
<td>5.5</td>
<td>1.038</td>
<td></td>
</tr>
</tbody>
</table>
S2. Curvature analysis of the branched microchannel

In the case of branched liquid template, the sharp angle between adjacent branches forms a small curvature radius ($R_{\text{out}}$ in Fig. S4). While the curved liquid surface forms a curvature radius ($R_{\text{in}}$ in Fig. S4). As shown in Equation. Group S1, the Laplace pressure $P_{\text{out}}$ caused by the $R_{\text{out}}$ is greater than the $P_{\text{in}}$ caused by the $R_{\text{in}}$, which drives the mass transfer to the joint. The mass transfer increases the $R_{\text{out}}$ and decrease the $P_{\text{out}}$. When the $R_{\text{out}}$ is equal to $R_{\text{in}}$ the mass transfer stop and the sharp angle transforms to fillet angle.

\[
P_{\text{out}} = \frac{2\gamma}{R_{\text{out}}} \quad P_{\text{in}} = \frac{2\gamma}{R_{\text{in}}}
\]

And

\[
R_{\text{out}} < R_{\text{in}}
\]

So

\[
P_{\text{out}} > P_{\text{in}}
\]

(Equation. Group S1)

Fig. S4 Scheme of the curvature analysis for mass transfer
S3. Curvature analysis of the junction between two channels with very different diameters

In the case of a junction between two channels with different diameters, the mass transfer driven by curvature difference should be taken into consideration. Fig S5 (a) schemes a newly prototyped junction, which has four curvature radius. \( R_1 \) and \( R_2 \) (\( R_1 > R_2 \)) represent the curvature radius of the two channels, respectively, while \( R_{S1} \) and \( R_{S2} \) are the curvature radius of the sharp corners at the junction. \( R_{S1} \) and \( R_{S2} \) are far smaller than \( R_1 \) and \( R_2 \). The corresponding Laplace pressure equations are as follows:

\[
\begin{align*}
P_1 &= \frac{2\gamma}{R_1} \\
P_2 &= \frac{2\gamma}{R_2} \\
P_{S1} &= \frac{2\gamma}{R_{S1}} \\
P_{S2} &= \frac{2\gamma}{R_{S2}} \\
\text{And} \quad R_{S1} < R_1 < R_2 \text{ and } R_{S2} < R_2
\end{align*}
\]

\[
\text{So} \quad P_{S1}, P_{S2} > P_1, P_2
\]

According to the equations above, the Laplace pressures \( P_1 \) and \( P_2 \) caused by \( R_1 \) and \( R_2 \) are larger than the \( P_{S1} \) and \( P_{S2} \) caused by the \( R_{S1} \) and \( R_{S2} \). The Laplace pressure difference would result in mass transfer to decrease curvature difference. The directions of the mass transfer are supposed to be along with the radial direction of \( R_{S1} \) and \( R_{S2} \), which point inside and outside of the template, respectively.

The mass transfer would lead to two phenomena. Firstly, a curvature gradient between the two channels forms and the junction becomes smooth (Place I in Fig. S5 (b)). Secondly, the mass transfer also results in the change of the channel radius. The region of the channel near the junction becomes thinner (taking Place II in Fig. S5 (b) for example) than the rest of the same channel (\( R'_2 < R_2 \)).

Due to the high viscosity of the ink in the paper, the mass transfer driven by the curvature difference would become slower and ignorable as the pressure gradient reaches a certain value. Then, the junction becomes stable. To verify the analysis above, a junction between a channel with a diameter of about 200μm and the other with about 600 μm is fabricated, as shown in Fig. S5 (c) (Note: a serial of optical images are integrated together).

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**Fig. S 5 (a)** Sketch of the newly prototyped junction between two channels with different diameters; **(b)** Sketch of the junction after mass transfer driven by curvature difference; **(c)** The junction between channel with diameter of about 200 μm and channel with diameter of about 600 μm (scale bar~200 μm).
S4. Fabrication resolution of microchannels

In addition to the microchannels with the diameters ranging from 200 to 900 μm (as shown in Figure 2(b) (d)), the microchannels with the diameter smaller than 100 μm have also been fabricated. **Fig. S6** exhibits the channels with the diameter of about 50 and 25μm. So far, the highest resolution of this approach is about 25 μm (**Fig. S6 (a)**).

![Microchannels images](image)

**Fig. S6** Microchannels with the diameters of about 25μm (a) and 50 μm (b).

![Microchannels images](image)

**Fig. S7** Microchannels with the diameters of about 200μm ~600 μm.

Eq. S1 Chemical reaction of the polymerization and modification during the formation of micorchannel

\[ R_3SiH + CH=CH-R' \xrightarrow{\text{Catalyst}} R_3Si-CH-CH-R' \]  

\[ R_3SiH + n\text{C}
\text{H}_2\text{C}=\text{O} \xrightarrow{\text{Catalyst}} R_3Si\text{CH}_3 \text{O}\text{C}_2H_5\text{O} \]
**S5. Confirmation of PEG on the internal surface of modified microchannels**

The high resolution X-ray photoelectron spectra (XPS) of C 1s peaks were recorded to confirm the existence of PEG groups on the internal surface of PEG modified microchannels. Fig. S8 shows the main C 1s peak (C-H) of the unmodified PDMS microchannels at the binding energy of 285 eV. While an extra peak in the C 1s region at 286.7 eV attributed to carbons bond to PEG oxygen atoms (C-O), about 1.7 eV higher than the main C 1s peak (C-H) at 285 eV appears on the internal surface of PEG modified PDMS microchannel. Furthermore, elemental quantitative analysis by XPS is carried out and shown in Table S2. The result reveals an increase in the amount of C atoms and O atoms, while a decrease in the amount of Si atoms in the PEG modified PDMS channel surface.

![Fig. S8](image1.png)

**Fig. S8** High resolution XPS spectra of C 1s peaks of the internal surface of the unmodified PDMS microchannel (a) and the PEG modified microchannel (b).

<table>
<thead>
<tr>
<th>Table S2</th>
<th>General Ratio of the elements of PDMS and PEG modified PDMS microchannel internal surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample</td>
<td>C-H</td>
</tr>
<tr>
<td>unmodified</td>
<td>—</td>
</tr>
<tr>
<td>PEG modified</td>
<td>40.3</td>
</tr>
</tbody>
</table>

![Fig. S9](image2.png)

**Fig. S9** XPS spectra of PDMS (in black) and PEG modified (in red) microchannel internal surface
S6. Different capillary rise between unmodified microchannel and PEG modified microchannel

To investigate the wetting properties of the PDMS microchannels and the PEG modified microchannels, capillary rise tests were carried out. Microchannel was perpendicularly placed with one end immersed into water. OCA20 machine was used to observe the height of capillary rise of water in microchannels. Fig. S10 shows the images of the capillary rise of water in PDMS microchannel and PEG modified microchannel. Due to the hydrophobicity of the PDMS, there is no capillary water rise in the unmodified PDMS microchannel. While in the PEG modified microchannel, a capillary water rise is observed obviously due to the hydrophilic hydroxyl group.

Fig. S10 The images of the capillary rise of water in unmodified microchannel (left) and PEG modified microchannel (right) (scale bar=1000 μm).