Supporting Information

Microfluidic gradient device for simultaneously preparing four distinct types of microparticles

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\end{itemize}

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<table>
<thead>
<tr>
<th>Table 1 Analogy between electronics and microfluidics</th>
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<tbody>
<tr>
<td><strong>Electronics</strong></td>
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<tr>
<td>Electric current $I$/Amp</td>
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<tr>
<td>Voltage drop $\Delta V$/Volt</td>
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<tr>
<td>Electric resistance $R_E$/Ω: $R_E \propto L/A$</td>
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<tr>
<td>Ohm’s law: $V = IR_E$</td>
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The designed microfluidics device is composed of 11 channel segments ($L_1, L_2, \ldots, L_{11}$), 4 meshes (M1, M2, M3, M4), 5 nodes (N1, N2, N3, N4, N5). The
flow rates of channel segments are $Q_1, Q_2, \ldots, Q_{11}$.

According to the diffusive mixing equation, the 3/7 ratio of $Q_9$ and $Q_{10}$ can be obtained. As the same way, the 4/3 ratio of $Q_5$ and $Q_6$ can be obtained. Let $L_6= L_8= L_{10}= L_{11}= a$, $L_9= b$, $L_7= c$, and $Q_7= Q_8= Q_9= Q_{10}= Q$. Kirchhoff’s current law (KCL) indicates that the algebraic sum of the currents entering any node is zero: $I_1 + I_2 + \cdots + I_N = 0$, similarly $\sum Q_n = 0$.

Node 1 (N1): $Q_1 + Q_5 - Q_8 + Q_9 = 0$

Node 2 (N2): $Q_2 - Q_5 - Q_6 = 0$

Node 3 (N3): $Q_3 + Q_6 - Q_7 = 0$

Node 4 (N4): $Q_7 - Q_9 - Q_{10} = 0$

Node 5 (N5): $Q_4 + Q_{10} - Q_{11} = 0$

$Q_8 + Q_{11} = 4Q_1$

The volumetric flow rate of the gradient module channel can be obtained by solving the above equations. $Q_5 = 4/7Q$, $Q_6 = 3/7Q$, $Q_7 = 10/7Q$, $Q_8 = 2Q$, $Q_9 = 3/7Q$, $Q_{10} = Q$, and $Q_{11} = 2Q$.

Kirchhoff’s voltage law (KVL) indicates that the algebraic sum of the voltages around any closed path is zero: $V_1 + V_2 + \cdots + V_N = 0$, similarly $\sum P_n = 0$. 

Fig. S1 schematic of gradient generator
Meshe 1 (M1): \( Q_1L_1-Q_2L_2-Q_3L_3=0 \)

Meshe 2 (M2): \( Q_3L_3+Q_7L_7+Q_{10}L_{10}-Q_4L_4=0 \)

Meshe 3 (M3): \( Q_2L_2+Q_6L_6-Q_3L_3=0 \)

Meshe 4 (M4): \( Q_9L_9+Q_7L_7+Q_9L_9-Q_5L_5=0 \)

The channel length of the gradient generator can be calculated by solving the above equations. 

\[
L_1=\frac{3}{7}a+\frac{1}{3}b+\frac{17}{7}c, \quad L_3=\frac{3}{7}a+b, \quad \text{and} \quad L_5=\frac{3}{4}a+\frac{3}{4}b+\frac{5}{2}c.
\]

Let \( L_6=L_8=L_{10}=L_{11}=a=7 \text{ mm}, \ L_9=b=14 \text{ mm}, \text{ and } L_2=L_7=c=21 \text{ mm} \). Then, the length of the gradient generator can be obtained.

**Table 2** Productivity of the microfluidic gradient device

<table>
<thead>
<tr>
<th></th>
<th>OL-1</th>
<th>OL-2</th>
<th>OL-3</th>
<th>OL-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average diameter (μm)</td>
<td>156.3</td>
<td>153.2</td>
<td>155.2</td>
<td>158.2</td>
</tr>
<tr>
<td>Productivity (10^5 /h)</td>
<td>1.25</td>
<td>1.33</td>
<td>1.28</td>
<td>1.2</td>
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Fig. S2 Photo of silicon wafer with eight outlets microchannel
Fig. S3 The image of microfluidics gradient chip with eight outlets

Fig. S4 Water contact angles measure (a) PLGA/DMC; (b) PCL/DMC

References