Supporting Information

Microfluidic gradient device for simultaneously preparing four distinct types of microparticles

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Table 1 Analogy between electronics and microfluidics

Electronics	Microfluidics
Electric current I/Amp	Volumetric flow rate Q/m^{3}s^{-1}
Voltage drop ΔV/Volt	Pressure drop Δp/Pa
Electric resistance R_E/Ω: $R_E \propto$L/A	Hydraulic resistance R_H/Pa s^3 m^{-1}: $R_H \propto$L/A^2
Ohm's law: $V = IR_E$	Hagen-Poiseuille's law: $\Delta p = QR_H$

The designed microfluidics device is composed of 11 channel segments (L_1, L_2 $\cdots L_{11}$), 4 meshes (M1, M2, M3, M4), 5 nodes (N1, N2, N3, N4, N5). The flow rates of channel segments are $Q_1, Q_2 \cdots Q_{11}$.

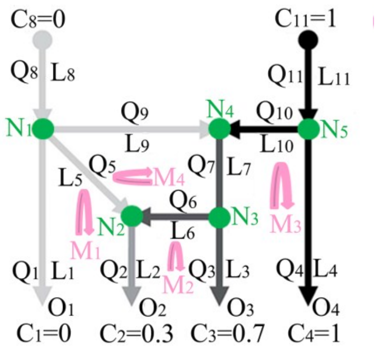

Fig. S1 schematic of gradient generator

According to the diffusive mixing equation,[1] the 3/7 ratio of Q_9 and Q_{10} can obtain. As the same way, the 4/3 ratio of Q_5 and Q_6 can obtain. Let $L_6=L_8=L_{10}=L_{11}$=a, L_9=b, $L_2=L_7$=c, and $Q_1=Q_2=Q_3=Q_4=Q$. 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 $\sum P_n=0$.

Meshe 1 (M1): $Q_1L_1–Q_2L_2–Q_5L_5=0$

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): $Q_6L_6+Q_7L_7+Q_9L_9–Q_5L_5=0$

The channel length of the gradient generator can be calculated by solving the above equations. L_1=3/7a+1/3b+17/7c, L_3=3/7a+b, and L_5=3/4a+3/4b+5/2c. Let $L_6=L_8=L_{10}=L_{11}$=a=7 mm, L_9=b=14 mm, and $L_2=L_7$=c=21 mm. Then, the length of the gradient generator can be obtained.

Table 2 Productivity of the microfluidic gradient device

	OL-1	OL-2	OL-3	OL-4
Average diameter (μm)	156.3	153.2	155.2	158.2
Productivity (10^5 /h)	1.25	1.33	1.28	1.2

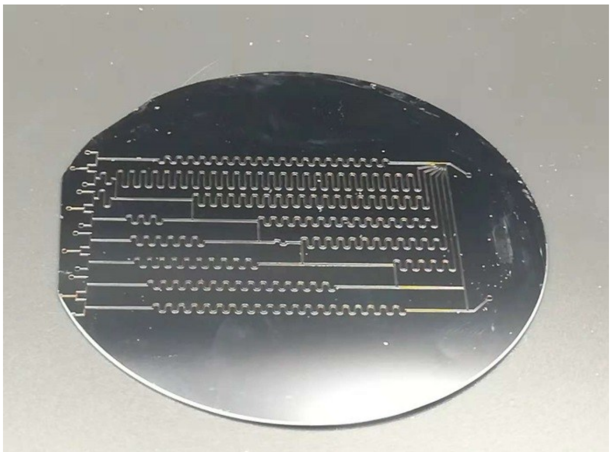

Fig. S2 Photo of silicon wafer with eight outlets microchannel

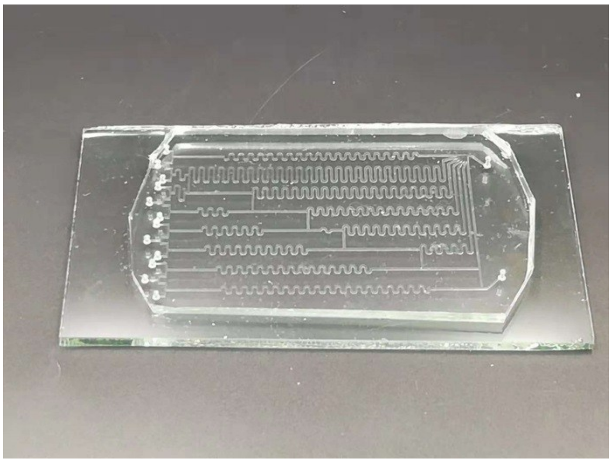

Fig. S3 The image of microfluidics gradient chip with eight outlets

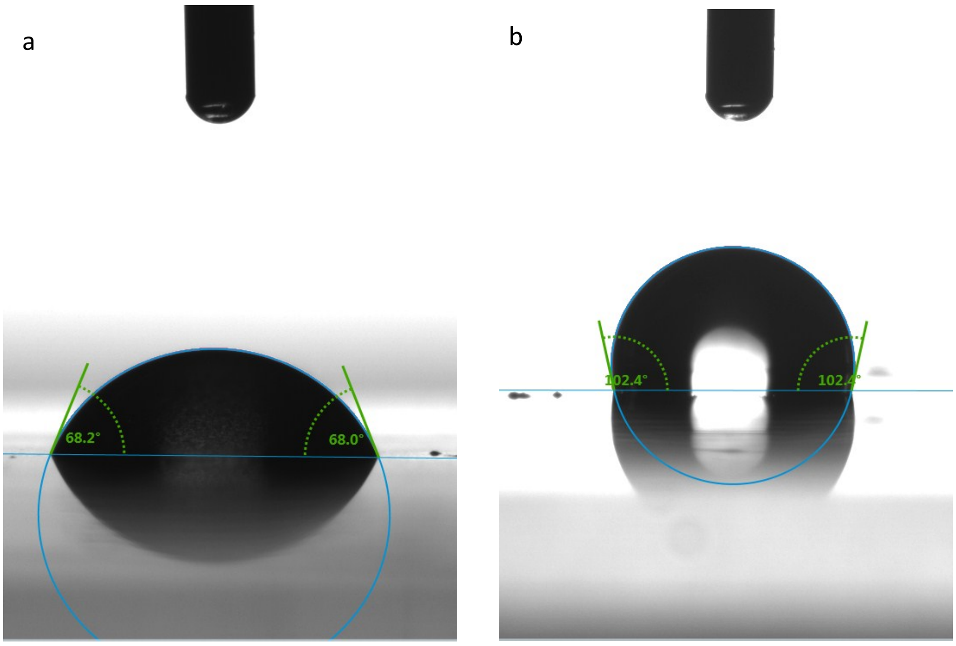

Fig. S4 Water contact angles measure (a) PLGA/DMC; (b) PCL/DMC

References

1 K. W. Oh, K. Lee, B. Ahn and E. P. Furlani, *Lab Chip*, 2012, **12**, 515-545.