Electronic Supplementary Material (ESI) for RSC Advances.

Supporting information

3D printed modules for integrated microfluidic devices

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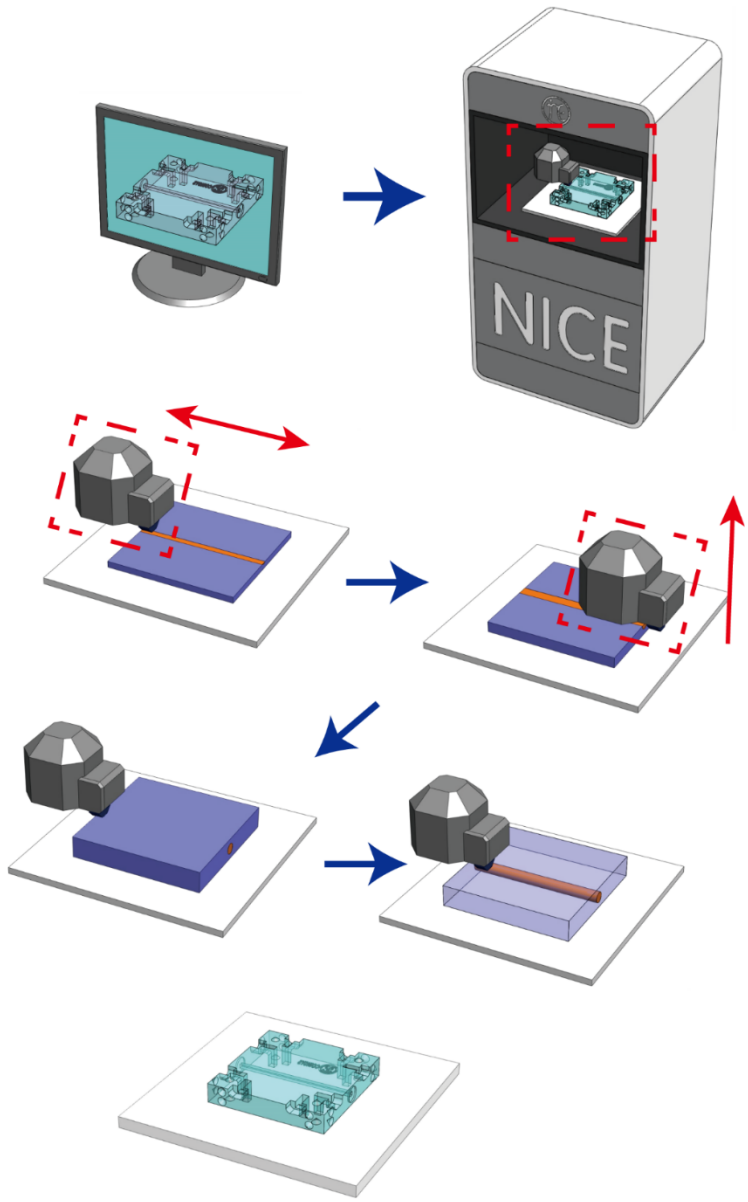


Fig. S1. 3D printing mechanism for module fabrication.

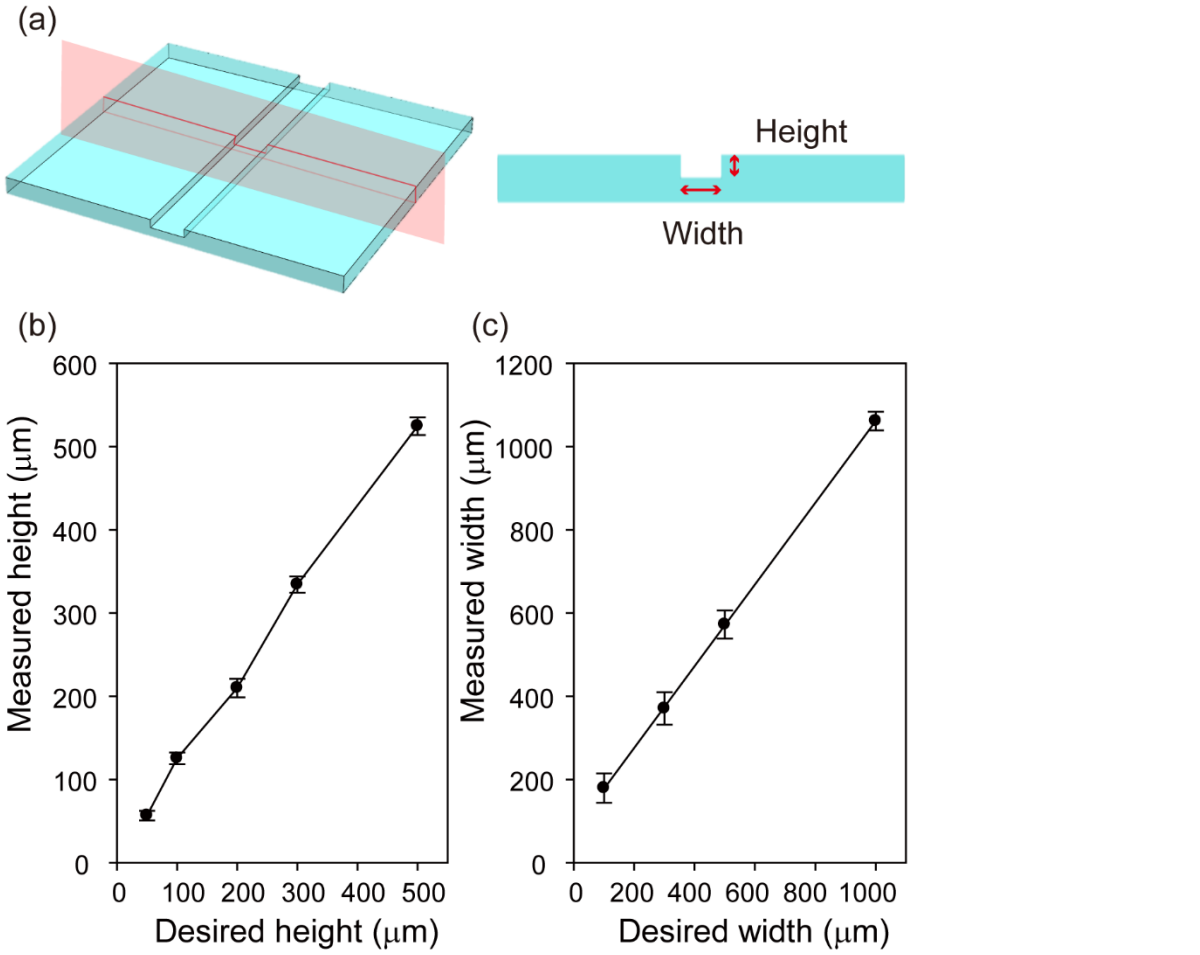


Fig. S2. (a) A series of height and width measurement of 3D printed modules. Dimension comparison graphs of designs and actual device of (b) height and (c) width of microchannels.

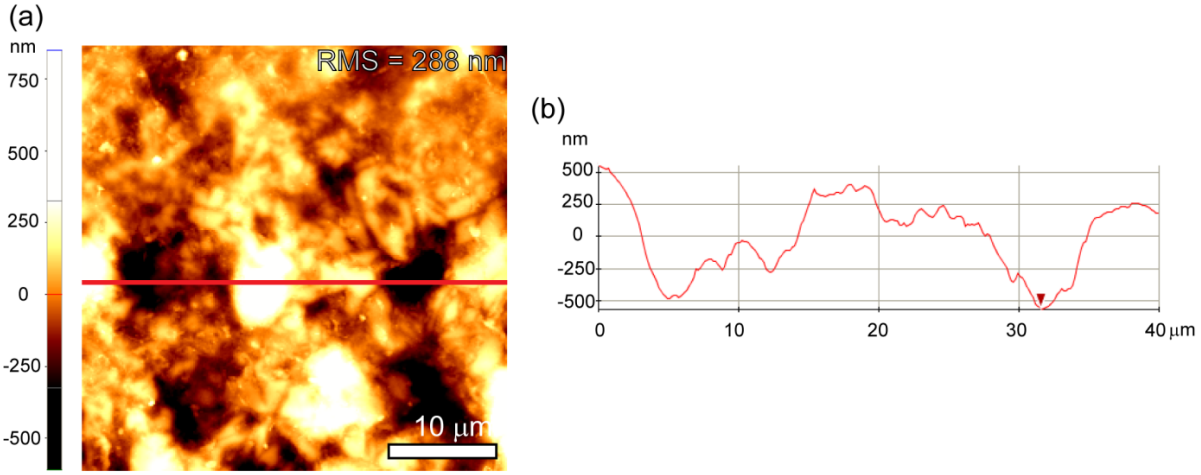


Fig. S3. AFM images of module surface.

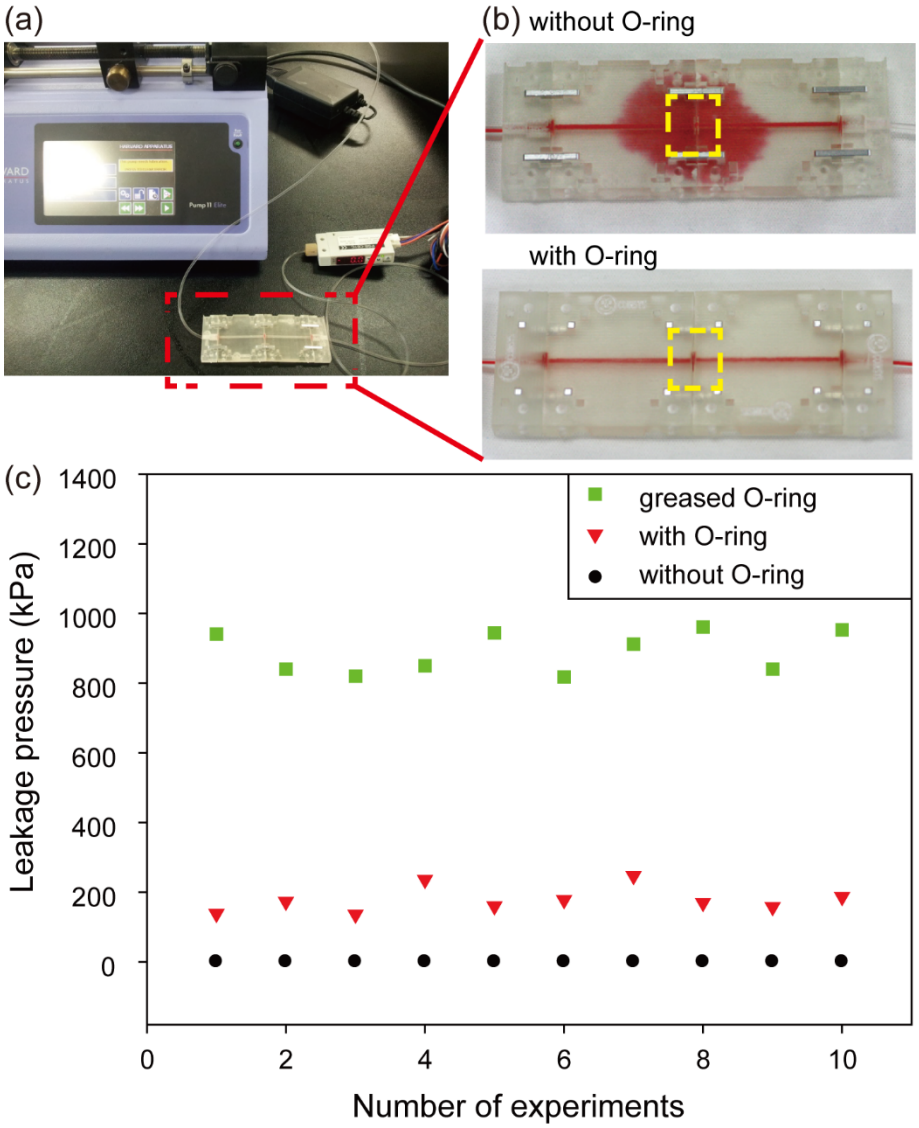


Fig. S4. Picture of (a) experimental setup for leakage test and (b) dye solution leakage with and without present of rubber O-ring. (c) Mechanical stability graph of modules without, with, and greased O-rings under various pressure.

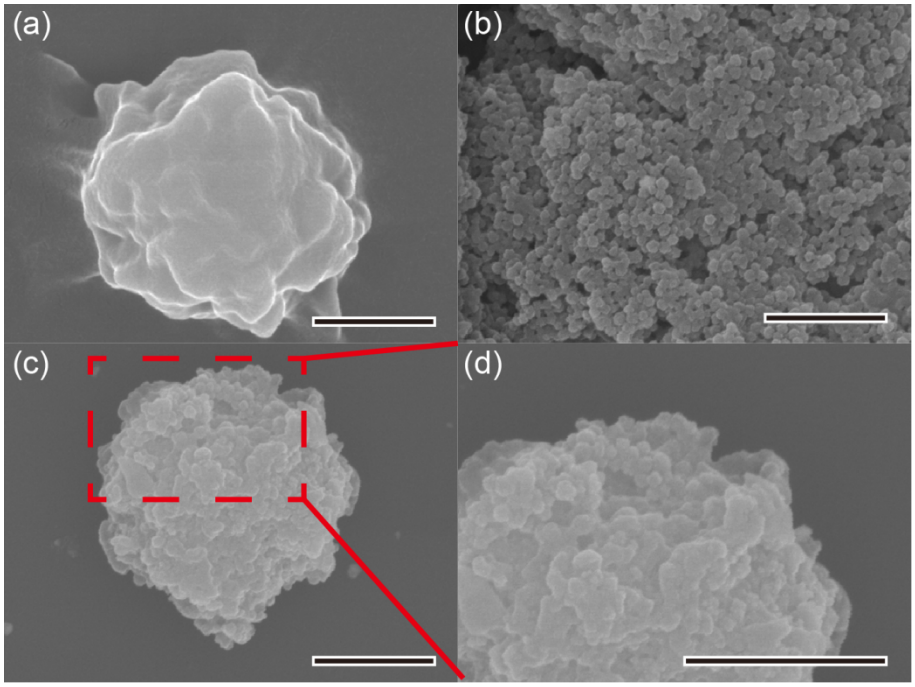
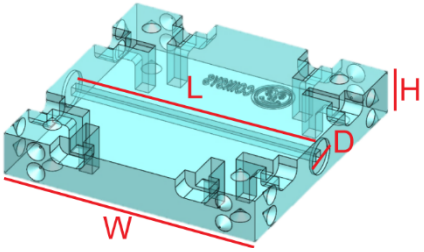
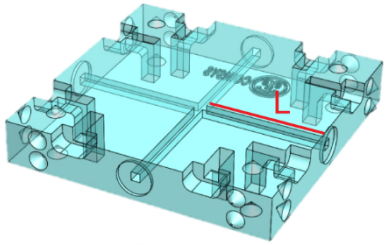
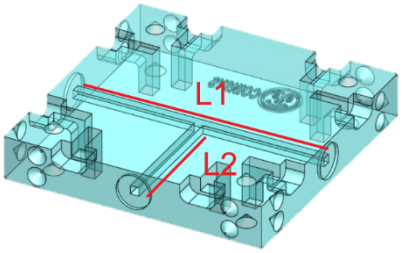
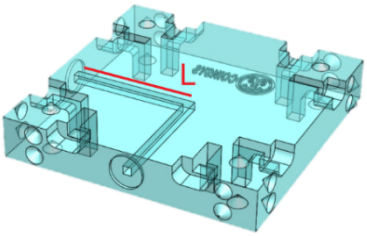
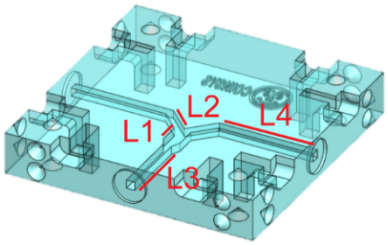
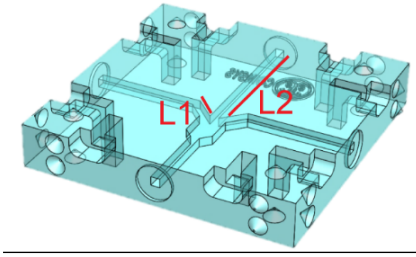
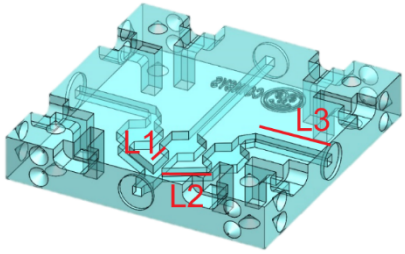
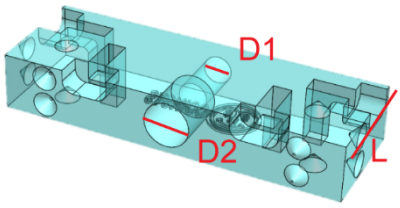
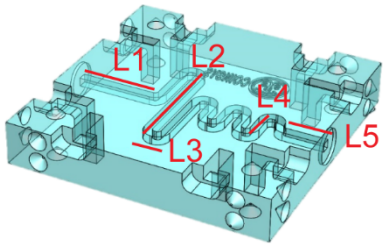
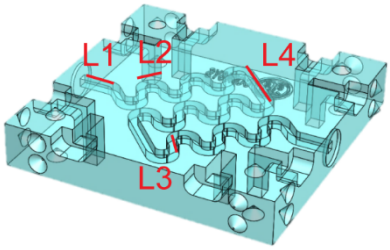
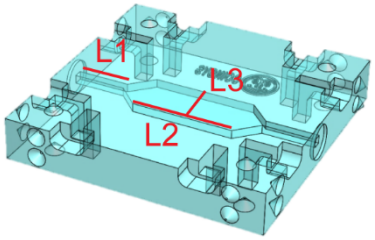
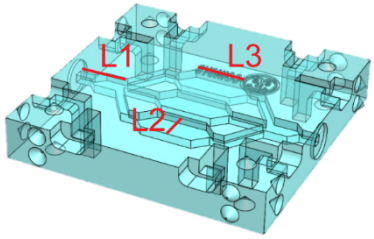
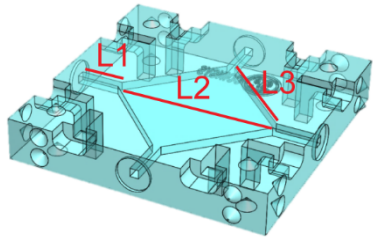


Fig. S5. SEM images of (a) pristine carboxylated magnetic particle, (b) pristine G–SNPs, and (c–d) antigen and antibody reacted G–SNPs–magnetic complex particles. (Scale bars are 500 μm)

Table S1. Schematic diagram of various types of module components and their function and detailed dimension.

Schematic	Name	Function	Dimensions (mm)
	Straight channel	To construct a straight channel	L : 29.3 W : 30.0 H : 5.0 D : 4.0
	Cross channel	To merge/divide flows	L : 14.2
	T channel	To merge/divide flows	L1 : 29.3 L2 : 14.2
	Right angled channel	To turn a flow direction	L : 14.2
	Y–shaped channel	To merge/divide flows	L1 : 2.5 L2 : 2.8 L3 : 8.4 L4 : 11.9
	Ψ–shaped channel 1	To merge/divide flows	L1 : 2.3 L2 : 16.4

	Ψ–shaped channel 2	To merge/divide flows	L1 : 3.4 L2 : 4.5 L3 : 8.9
	Inlet/outlet	To connect tubing into block assembly	D1 : 2.5 D2 : 4.0 L : 10.0
	Mixer 1	To mix a solution	L1 : 8.8 L2 : 15.0 L3 : 3.0 L4 : 5.0 L5 : 4.8
	Mixer 2	To mix a solution	L1 : 3.5 L2 : 2.8 L3 : 2.5 L4 : 6.6
	Reactor/chamber 1	To react/collect a solution	L1 : 6.2 L2 : 12.0 L3 : 6.0
	Reactor/chamber 2	To react/collect a solution separately	L1 : 6.2 L2 : 6.0 L3 : 4.0
	Reactor/chamber 3	To react/collect a solution with a relatively large volume	L1 : 5.2 L2 : 19.0 L3 : 9.0

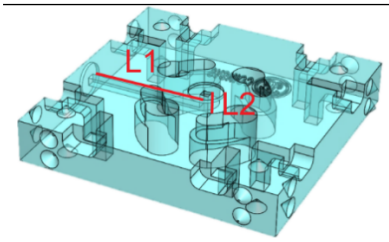
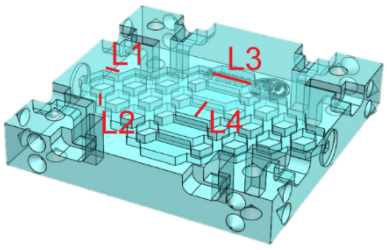
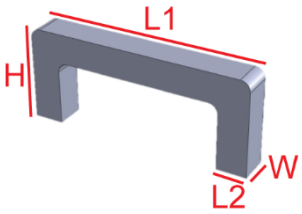
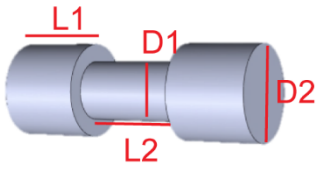
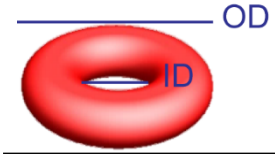
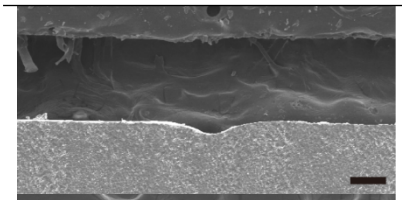
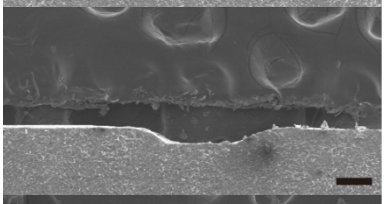
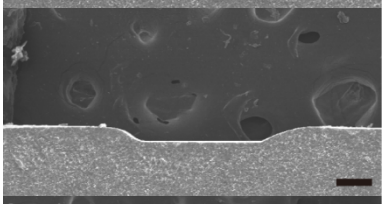
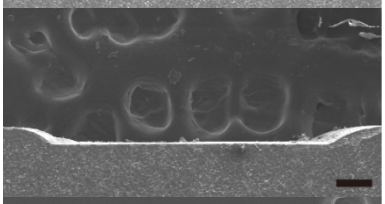
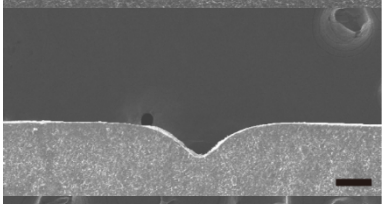
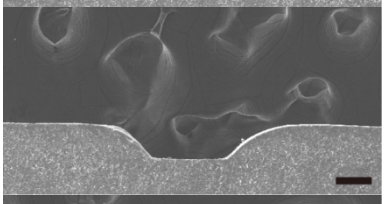
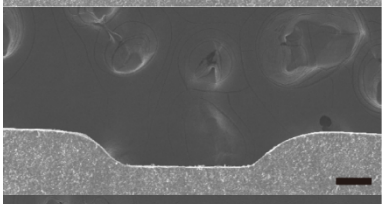
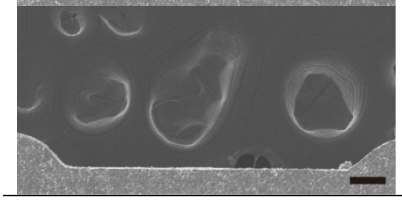
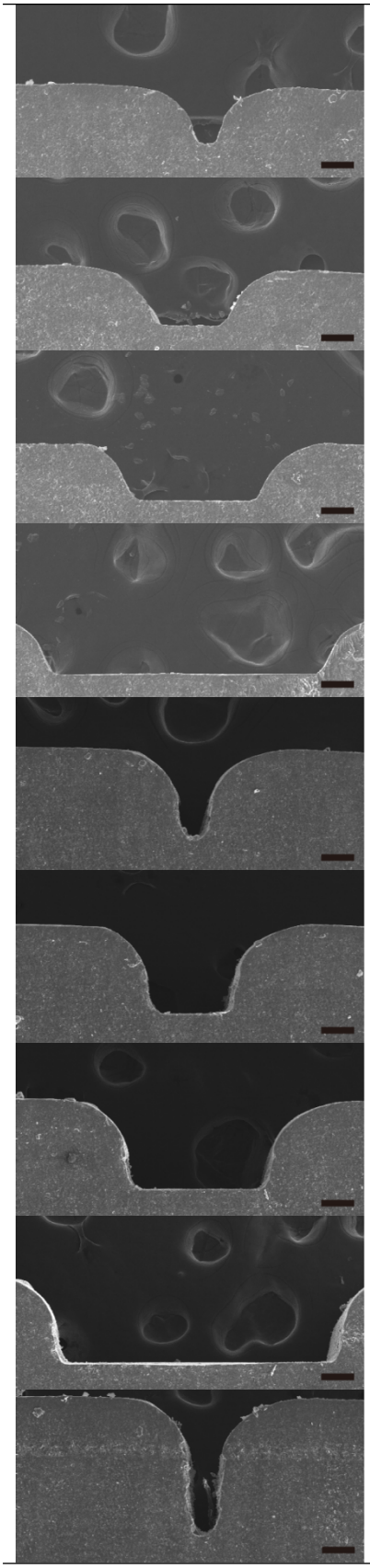
	Z axis connector	To connect two blocks in multi–layer	L1 : 14.2 L2 : 1.2
	Gradient generator	To provide concentration gradient with reactor/ chamber	L1 : 2.0 L2 : 1.0 L3 : 5.4 L4 : 3.4
	Horseshoe pin	To horizontal connect two blocks	L1 : 11.5 L2 : 1.5 H : 4.8 W : 1.5
	Dumbbell pin	To vertical connect two blocks	L1 : 3.0 L2 : 4.0 D1 : 2.2 D2 : 3.5
	O–ring	To tight connect between two blocks	OD : 3.8 ID : 1.0

Table S2. SEM images of 3D printing microchannel with different height and width. (H : height, W : width, All the scale bars are 100 μm)

Image	Designed dimension (μm)	Measured dimension (μm)
	H : 50 W : 100	H : 51 W : 114
	H : 50 W : 300	H : 60 W : 295
	H : 50 W : 500	H : 57 W : 505
	H : 50 W : 1000	H : 58 W : 1021
	H : 100 W : 100	H : 120 W : 171
	H : 100 W : 300	H : 125 W : 372
	H : 100 W : 500	H : 126 W : 582
	H : 100 W : 1000	H : 130 W : 1089

	H : 200 W : 100	H : 204 W : 199
	H : 200 W : 300	H : 217 W : 384
	H : 200 W : 500	H : 216 W : 592
	H : 200 W : 1000	H : 203 W : 1069
	H : 300 W : 100	H : 335 W : 206
	H : 300 W : 300	H : 341 W : 401
	H : 300 W : 500	H : 335 W : 595
	H : 300 W : 1000	H : 326 W : 1069
	H : 500 W : 100	H : 514 W : 207

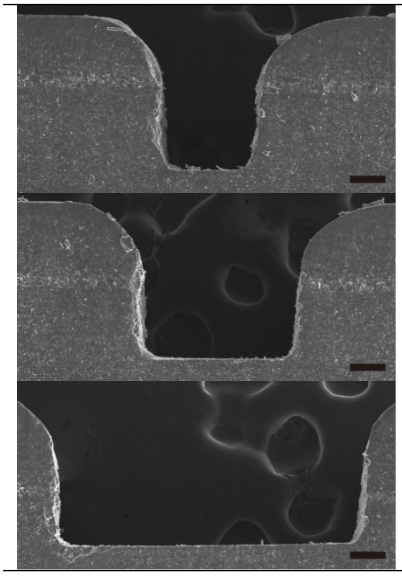
	H : 500 W : 300 H : 500 W : 500 H : 500 W : 1000	H : 524 W : 400 H : 536 W : 589 H : 524 W : 1059

Table S3. Chemical resistance of rubber O-ring and UV resins for fabrication of functional modules.

Solvents	Rubber O-ring	UV resin (VisiJet Crystal)
HCl (4 wt%)	Unaffected	Unaffected
NaOH (10 wt%)	Unaffected	Unaffected
Acetone	Unaffected	Affected
Toluene	Unaffected	Affected
Ethanol	Unaffected	Unaffected
Water	Unaffected	Unaffected