Electronic Supplementary Material (ESI) for Lab on a Chip.

Electronic Supplementary Information (ESI)

Integrated microfluidic pumps and valves operated by finger actuation

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EXPERIMENTAL

Fabrication of the device

The device consists of three PDMS layers and a thin PDMS membrane (Fig. S1 (A)). PDMS layers, including fluidic and pneumatic channels, were obtained by replica molding from an SU-8 mold fabricated by photolithography to achieve a channel height of 100 μm, and the weir structures having a height of 5 μm. The width of the fluidic channels was designed to be 300 μm, the width of the pneumatic channels was designed to be 200 μm, and the width of the silica microbead column was designed to be 1 mm. A 30 μm thin PDMS was obtained by spinning the uncured PDMS on the bare silicon wafer at a speed of 1500 rpm for 60 s and cured at 150°C. PDMS layers were bonded each other using oxygen plasma treatment, and the holes were punched with a biopsy punch (Fig. S1 (B)). The alignment of the pneumatic and fluidic channels was done using the align marks in each layer. For nucleic acid purification device, incubated silica microbeads in 6 M guanidine hydrochloride were injected into the silica microbead column through the injection hole and were packed with the weir structures. Then, the injection hole was blocked with an acrylic block after washing the silica microbeads with ethanol and drying them using an air gun.

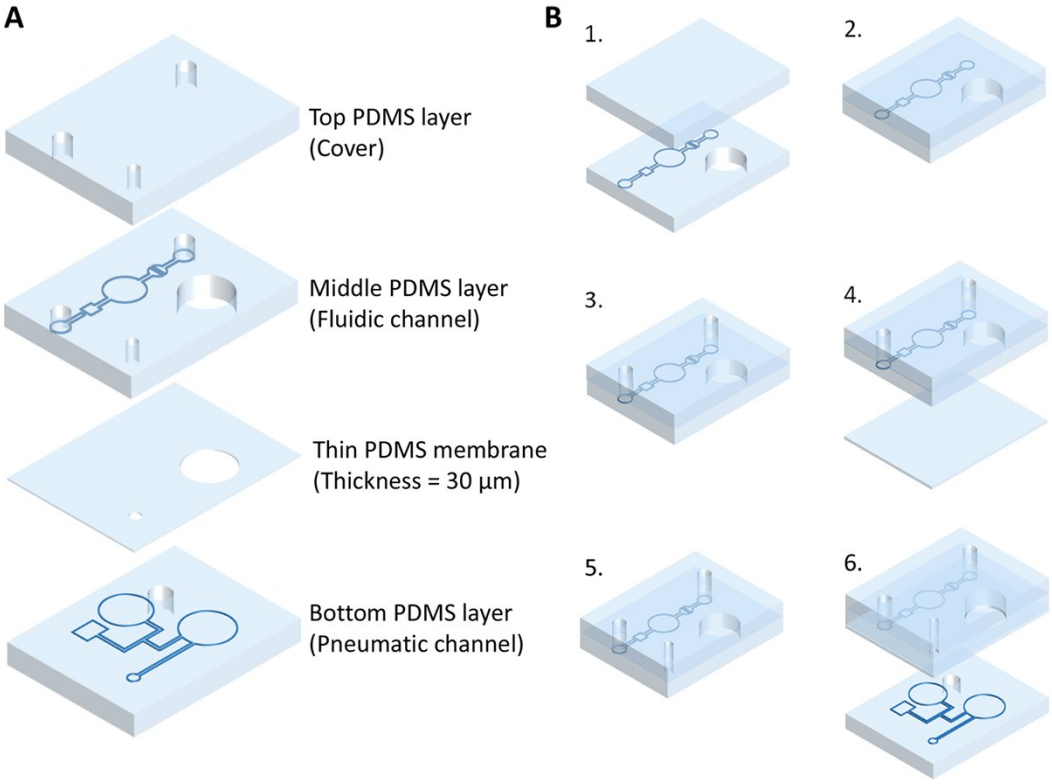

Fig. S1 (A) Configuration of the device. (B) Fabrication procedures.

Determination of the dispensed volume

To measure the dispensed volume, 1 mM erioglaucine solution (Sigma-Aldrich, St. Louis, MO, USA) was used which had a peak absorbance at 406 nm. By loading the 1 to 10 μL of 1 mM erioglaucine solution into the 200 μL of distilled water with an interval of 1 μL, the absorbance of the mixture was measured at 406 nm. Then, the calibration curve representing the relationship between volume and absorbance was obtained. The dispensed volume was calculated by measuring the absorbance.

Procedures for nucleic acids purification experiment

Synthetic hepatitis B virus (HBV) DNA in the Real-Q HBV quantification kit (Biosewoom, Seoul, Korea) was used to demonstrate nucleic acid purification on a finger-actuated microfluidic device. For nucleic acid purification, a sample solution, including nucleic acids, washing buffer, and elution buffer, was required. As a sample solution, synthetic HBV DNA and the binding buffer were mixed with a 4:9 ratio to assume the situation of lysed HBV. Binding buffer is consists of protease (Qiagen, Hilden, Germany), lysis buffer (Qiagen), ethanol with a ratio of 1:8:9. 70% Ethanol was used as washing buffer and the distilled water was used as elution buffer. As a solid-phase, silica microbeads with a diameter of 80 μm were injected into the silica bead column and were trapped by the weir structures whose height was about 5 μm. 6.5 μL of the sample solution was flowed into the silica bead column by pushing Button 1 and 8 μL of wash buffer was injected into the silica bead column by pushing Button 2. After drying the residual ethanol of wash buffer in the silica bead column, 10 μL of elution buffer was flowed into the silica bead column to elute the HBV DNA. Purification of HBV DNA was confirmed with real-time PCR (CFX 96, Biorad, CA, USA) using the Real-Q HBV quantification

kit. 20 µL of real-time PCR master mix was prepared according to the protocol and was mixed with 5 µL purified HBV DNA solution. Then, HBV DNA was amplified according to the following protocol (Table S1):

Table S1 Protocol for the real-time PCR.

Step	Temperature	Time	Cycle Number
1	50 ˚ C	2 min	1 cycle
2	95 ˚ C	10 min	1 cycle
3	95 ˚ C	20 s	45 cycles
	58 ˚ C	30 s	
	72 ˚ C	30 s	

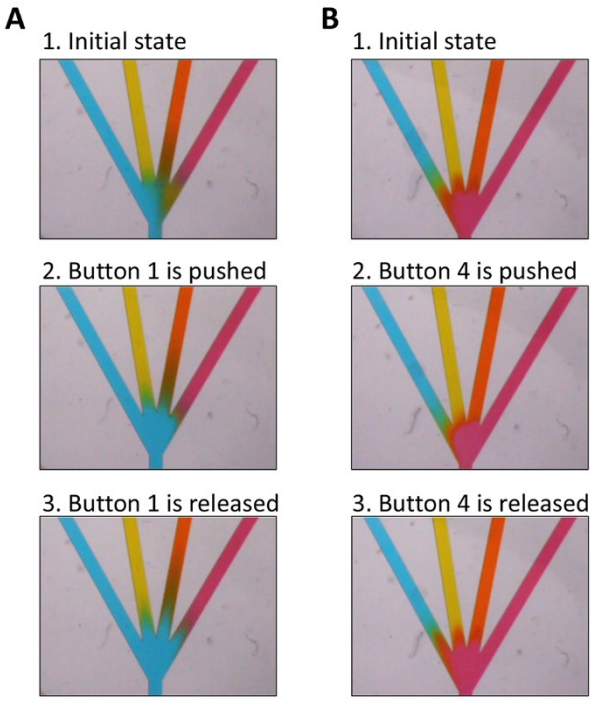

Fig. S2 (A) In the case of Button 1, there was a backflow when the button was pushed and released. (B) In the case of Button 4, there was a backflow when the button was released only.