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

Supplemental Document

On-Demand Magnetic Manipulation of Liquid Metal in Microfluidic channel for Electrical Switching Application

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1. Microfluidic Channel Fabrication

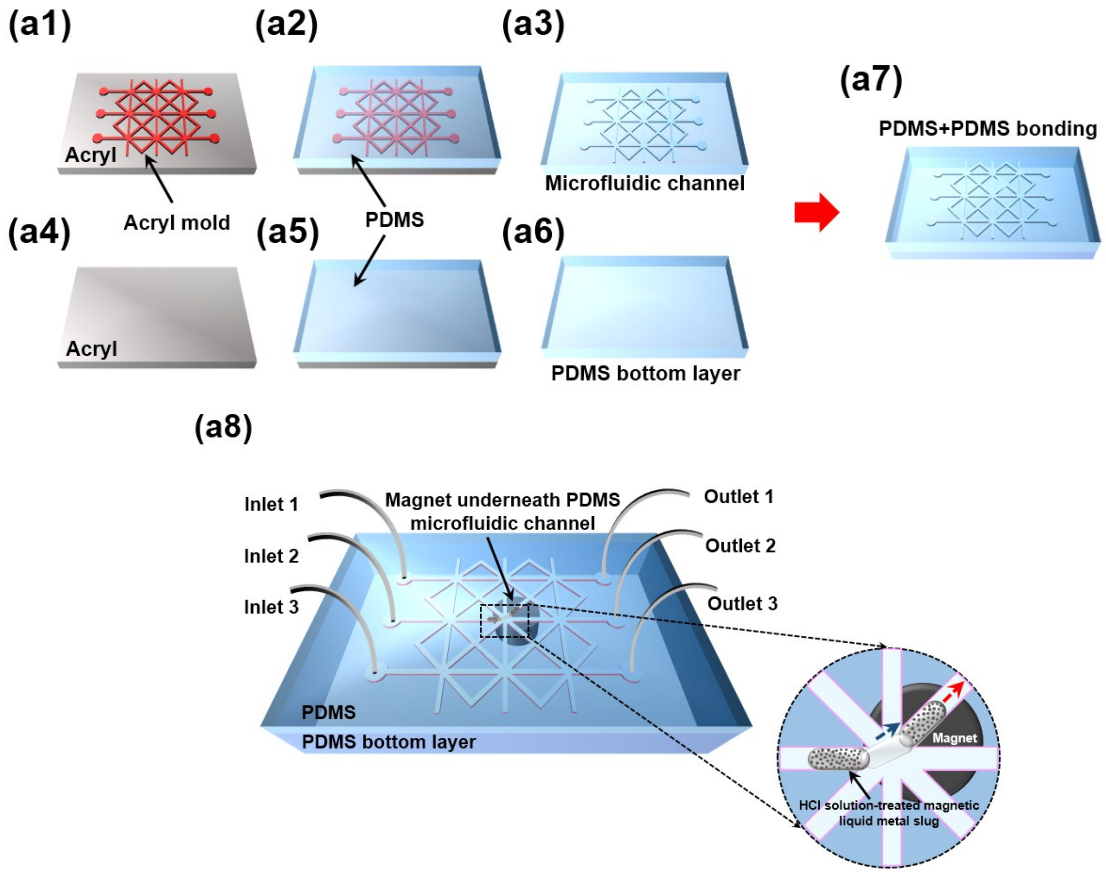

Figure S1. Schematic of fabrication process of the microfluidic channel: (a1, a4) acryl mold, (a2, a5) PDMS pouring, (a3, a6) peeling off, (a7) PDMS bonding and (a8) schematic of magnetic manipulation of HCl solution-treated magnetic liquid metal slug using an external magnet.

We fabricated all PDMS-based microfluidic channels utilized in this paper using soft photolithography. Here, we demonstrated one of the channels, a complicated spider-web like microfluidic channel, as all channels were fabricated with the same method. The spider-web like microfluidic channel was composed of 500 μm wide complicated spider-web like pattern and 6 ports (3 inlets and 3 outlets) for injection or inhalation of liquid metal by applying an air pressure. Fig. S1 (a1-a7) showed the fabrication process of the complicated microfluidic channel. The schematic of the channels was firstly designed using AutoCAD (Autodesk, USA) program. Then, a 1 mm thick acryl mold was fabricated by using a laser cutting machine (LaserCut 6.1. Laser Equipment Co. Ltd, Korea) for PDMS replication. The complicated microfluidic channel pattern was carved onto the top acryl plate by a laser cutter (a1). The acryl mold was filled with PDMS and cured in an oven at 90℃ for 60 min (a2). After curing, PDMS was peeled off from the top plate mold (a3). The bottom plate mold was created in the same process obtaining the top mold (a4). PDMS membrane was poured and baked in the oven, and then PDMS membrane was released from bottom plate (a5, a6). Finally, the top PDMS layer having microfluidic channel design and the bottom flat PDMS membrane (~2 mm thickness) were bonded by plasma treatment using a plasma cleaner (AMED-AT-Plasma, Korea), followed by hard baking on a hotplate at 180 ℃ for 50 min (a7). Then, the HCl solution-treated liquid metal was injected to the channel through the inlet ports. After HCl or NaOH solution was injected into the channel, the liquid metal was on-demand manipulated. By positioning the external magnet underneath the microfluidic channel, the magnetic liquid metal slug was readily moved along with the re-positioning the magnet (a8).