# Analyst
# Supplementary Information

**Title:** Piezo-Ring-on-Chip Microfluidic Device for Simple and Low-Cost Mass Spectrometry Interfacing

**Authors:** Chia-Wen Tsao, I-Chao Lei, Pi-Yu Chen, and Yu-Liang Yang

**Microchannel layer, upper holder layer, and bottom holder PDMS layer fabrication.**

We used standard PDMS soft lithography to fabricate the PDMS layer and photolithography process to produce SU-8 micromolds for PDMS casting. Figure S1, S2 and S3 show PDMS fabrication for microchannel layer, upper holder layer and bottom holder layer respectively. SU-8 micromold was used for the microchannel layer (Figure S1) and upper holder layer (Figure S2) PDMS casting. To create the SU-8 micromold, the silicon wafer are first cleaned and baked to eliminate particles and moisture from surfaces. Then spin coat SU-8 photoresist at 1000 rpm on the silicon wafer followed by baking at 95 ˚C for 25 min. Expose to UV light (AGL100 UV light source, M&R Nano Tech) for 150 seconds, and bake at 95 ˚C for 5 min after UV light exposure. Develop in SU-8 developer for 3~5 minutes, then bake at 130 ˚C for 8 hours The final thickness of the SU-8 micromold is measure around 60 μm. After SU-8 mold fabrication, PDMS is then poured onto the micromold for casting procedures.

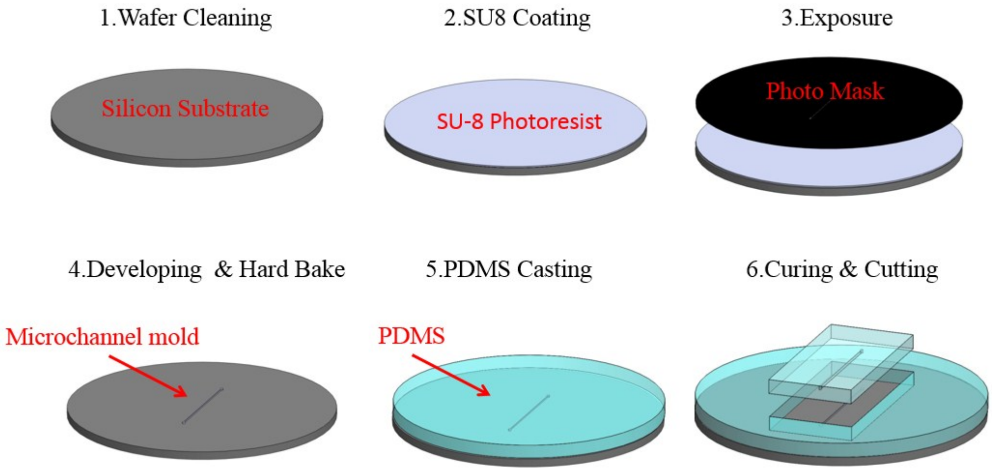



Figure S1. Microchannel PDMS layer fabrication

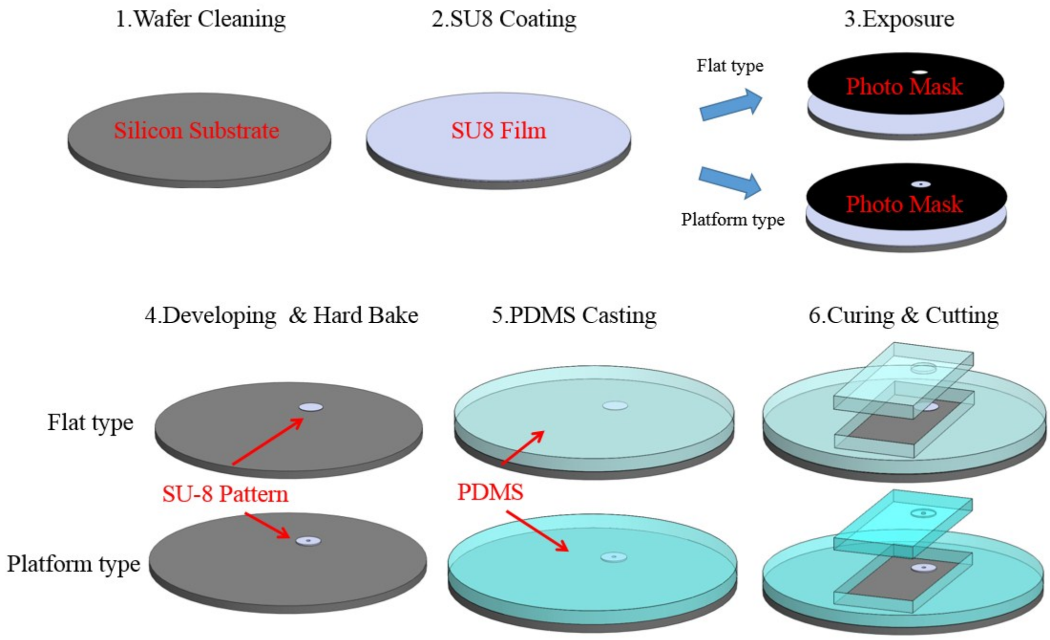



Figure S2. Upper holder PDMS layer fabrication

The bottom holder layer is designed to hold piezo ring. For the micromold fabrication, we cut a plastic pipette tips into a cone shape plastic ring as cone shape spraying nozzle (Figure S3-a) attached to a piezo ring as the micromold for bottom PDMS holder layer. The outer diameter of the plastic mold (8.87 mm) must be smaller than the diameter of piezo ring (10 mm).

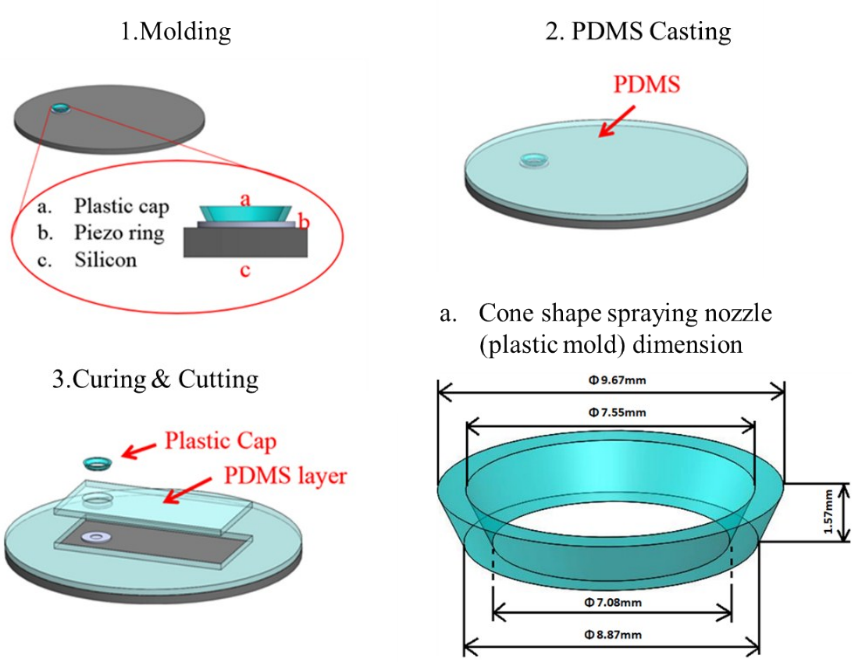
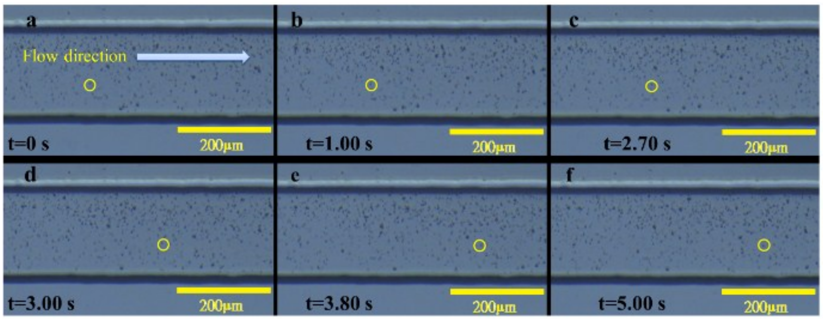



Figure S3. Bottom holder layer fabrication chart

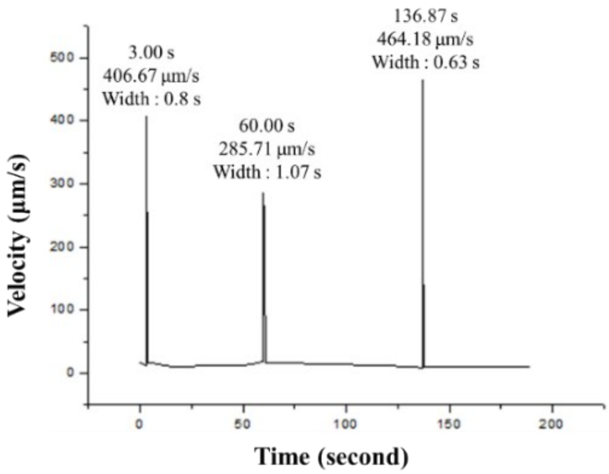
**Pulsatile pumping effects in microfluidic channel**

To measure the pulsatile pumping flow results from the piezo-ring, we added polystyrene beads in the microfluidic channel to visualize the pulsatile flows during the piezo-ring sprays as shown in Figure S4. The syringe pump was set to pump at a low flow rate of 10 μL/hr for easily tracing the polystyrene beads under a microscope. An average pulsatile flow velocity of 385.52 μm/s (maximum pulsatile flow velocity of 464.8 μm/s) with pulsatile cyclic times of 57 s and

76 s were observed during the piezo-ring spreading process. The pulsatile pumping video is also included in Movie S5 in the supplementary material.




(a)




(b)

Figure S4. (a) Microscope images of the polystyrene particles moving in the microchannel. The yellow circles indicate the particles traced to estimate the pumping flow effects, and (b) shows the pulsatile flows in the microchannel.

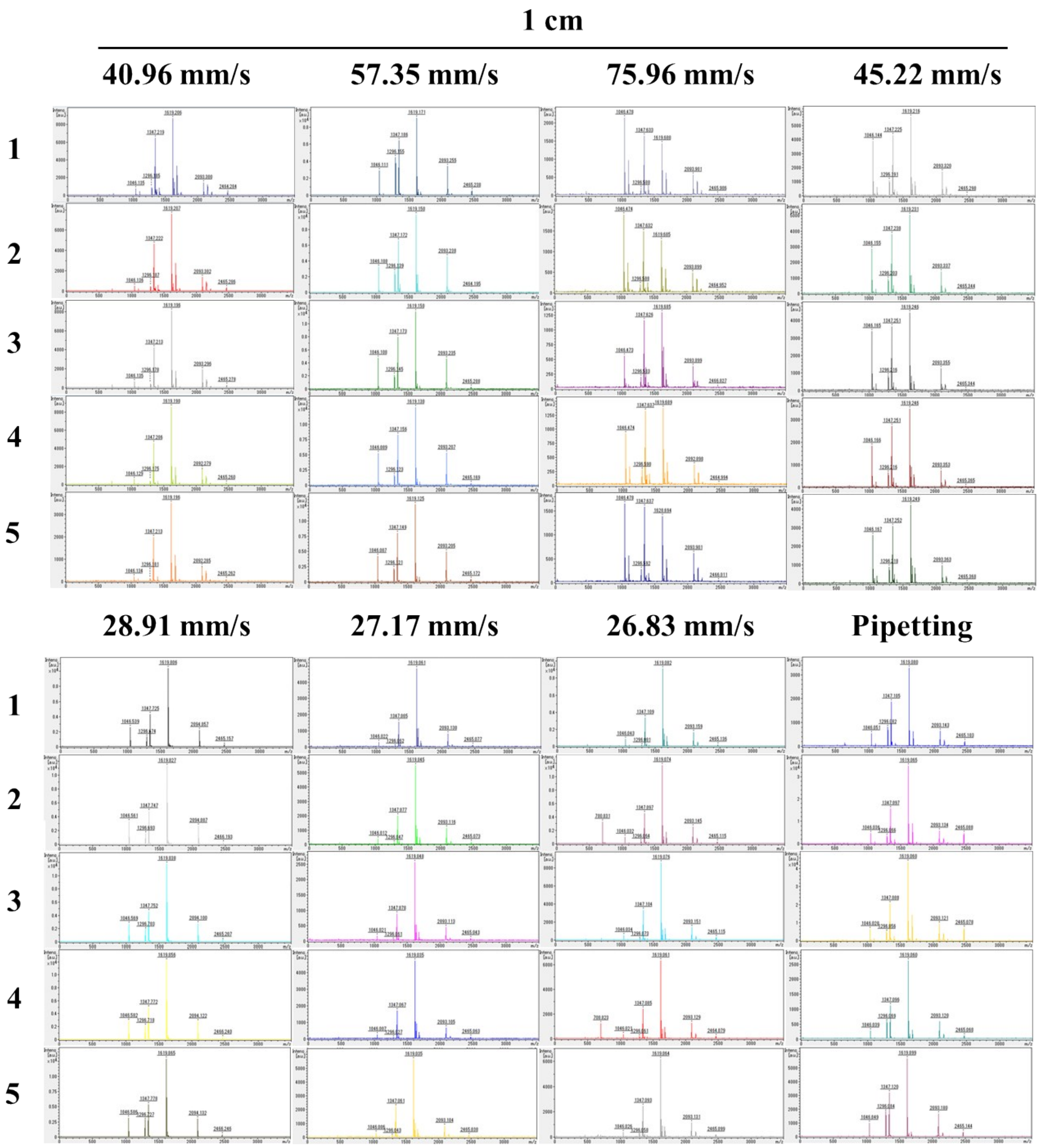



Figure S5. Mass spectrum of peptide sample MALDI-MS analysis using piezo-ring-on-chip microfluidic with printing speed below 50 mm/s and 1 cm distance