マイクロ流体チップとガラス製流体制御デバイス

Micro fluidic chip and glass microfluidic control devices

○田中 陽[1]（1. 理化学研究所生命システム研究センター）

°Yo Tanaka[1] (1.QBiC, RIKEN)

E-mail: yo.tanaka@riken.jp

In the last decades, lab-on-a-chip technology have become a major research field that aim to realize sophistication of analytical experiments. The incorporation of sophisticated functions in totally glass microfluidic chips exploiting remarkable characteristics of “ultra thin glass” is introduced here. The widely used material for microchips in the lab-on-a-chip field is polydimethylsiloxane (PDMS) due to its low cost, self-sealing, and elastomeric property. The problem is that they also have several disadvantages such as chemical and physical instability. On the other hand, glass is the most common material utilized to create multi-purpose integrated chemical systems. Especially in analytical field, optical transparency and durability against laser or acoustic wave is significant. However, glass is hard and fabrication is complicated, and so difficult to incorporate sophisticated microfluidic devices into a glass microchip. To address this problem, I propose to use a flexible, ultra thin glass fabricated using an overflow fusion downdraw process to realize a minimum thickness of a few micrometers. Ultra thin glass is too fragile to manipulate by hand especially in liquid due to the surface tension, but that process is indispensable for micro-fabrication. Therefore, a newly designed jig was used for ultra thin glass sheet handling. Using this jig, cleaning steps for glass fusion bonding required for the following steps were realized. Exploiting this device, totally glass based valves/pumps using ultra thin glass as a diaphragm were fabricated and demonstrated. Microchips were fabricated by wet-etching and thermal fusion to guarantee 100% glass. Fabricated microchips were set on a fluid jig to connect a micro fluidic control system (MFCS). The valve function was demonstrated using bimorph-type pin-based piezo actuators. Valve function in a 100-μm width, 50-μm depth linear channel were then demonstrated by visualizing fluid using fluorescent micro particles. The durable pressure was 3.0 kPa and the response time was about 0.12 s, which was shorter than that reported for similar PDMS-based valves. Peristaltic pump principle using 4-sequential valves was also demonstrated. Flow rates were proportional to actuating frequency, and the maximum flow rate was 0.8 μL/min. Performance of valves/pumps were included in a widely usable range for analytical use.