

Actuation of Pneumatic Valves for Trapping and Releasing Droplets

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Droplet-based microfluidic systems are of practical use for controlling chemical reactions and for transporting and manipulating chemical or biological materials at the nanoliter or picoliter scales. As one of droplet manipulations in the microfluidic devices, we demonstrated active droplet trapping and releasing using actuation of pneumatic valves in double-layer microfluidic devices. Uniform emulsion droplets were trapped at the junction of flow and control channels due to the expansion of flow channel into control valve channel. As long as shape of droplets was deformed in confined microchannels and flow rate of oil phase was relatively slow, the droplets were trapped in the expanded valve region because they can be restored into more spherical shape so that their surface energies become reduced. However, by applying pressurized gas to the control channels, expanded region underneath pneumatic valves was disappeared. Therefore, the trapped droplets could be released by actuating the pneumatic valves on demand.