Fabrication of controllable micro-patterns by droplet-based microfluidic photomasks

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Photomask is the opaque plate with transparent patterns used in a photolithography to fabricate micro-patterns. Fabricated patterned structures are widely used for sensing, bio-application, etc. A conventional film type photomask is widely used in photolithography as a powerful tool for creating various patterns. However, it would not be possible to manipulate the size, shape, or arrangement of photomask design in real time. Herein, we reported droplet-based microfluidic photomasks to fabricate various patterns with on-demand control. Monodisperse droplets were generated from microfluidic devices with high throughput. Generated droplets were hexagonally close-packed in the reservoir. It was possible to obtain spatially selective penetration of ultraviolet (UV) light because of water-soluble dye absorbing the UV light in continuous phase of fluid. Selectively penetrated UV light ensured the selective crosslinks of photoresist lying beneath the reservoir. Therefore, micro-patterned structures could be fabricated by exposing UV light to the photoresist film lying beneath the microfluidic devices. By adjusting the flow rates of the fluids, the shape, size and arrangement of droplets were easily tuned.