Generation of Micro-Droplets for the Study of Droplet Coalescence and Self-propulsion

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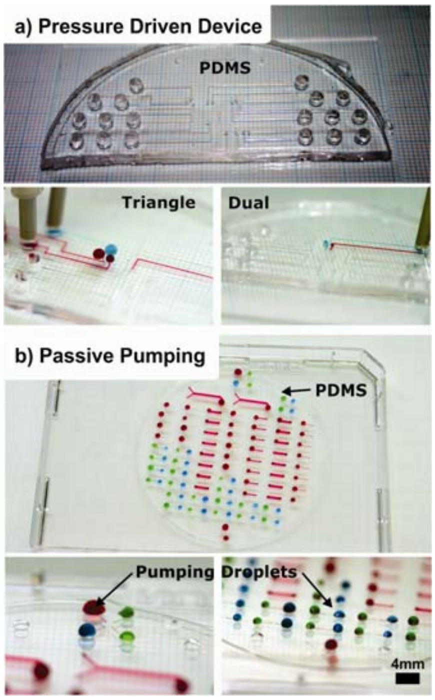
Microfluidic devices play an ever increasing role in nano- and biotechnologies. An example of the recent breakthrough allowed by such technologies is the Lab-on-a-Chip (LOC), which enables orders of magnitude downsizing of assay equipment. An emerging area of research in this technology-driven field is digital microfluidics based upon the micromanipulation of discrete droplets [1,2]. Microfluidic processing is performed on unit-sized packets of fluid which are transported, stored, mixed, reacted, or analysed in a discrete manner. Possible applications include on-chip assays, polymerase chain reaction, or DNA sequencing [1]. An obvious challenge however is how to displace sessile droplets on a substrate. A range of propulsion mechanisms has been proposed and investigated in the past. In the absence of a body force such as gravity, these techniques generally rely on capillary actuation by displacing the droplet away from its spherical configuration. One simple scenario to describe the coalescence of sessile droplets predicts a power-law growth of the bridge between the droplets [3]. To further validate this idea, a fluidic platform is required to experimentally investigate droplet coalescence and corresponding self-propulsion.



In this paper we introduce two microfluidic platforms capable of generating discreet droplets on a surface for self-propulsion experiments. Devices shown in Fig.1 are fabricated using a combination of processes commonly referred to in microfluidics as soft-lithography and exclusion replica-molding [4]. Central to these two processes is the creation of a dual-layer, reusable mold master in thick photoresist from which individual devices can be repeatedly replicated into soft silicon rubber. During experiments individual droplets on the device surface are generated by pumping the fluid of interest from the inlet hole through the micro-channel to the outlet hole. Actuation of the fluids in the channels is performed by either an external syringe pump connected to the inlet via tubing or using the passive pumping method [5].

References

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