Reconfigurable Microfluidic Platform

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Abstract

Lab-on-a-chip systems seek to leverage microfluidic chips to enable small-scale fluid manipulation, holding significant potential to revolutionize science and industry. However, existing microfluidic chips have been largely designed with static fluid structures for specific single-purpose applications, which lack adaptability and flexibility for diverse applications. Inspired by the general-purpose design strategy of the customizable chip of integrated circuit - Field Programmable Gate Array whose hardware can be reconfigured via software programming for multifunctionality after manufacturing, we have devised a conceptual-new reconfigurable microfluidic chip — Field Programmable Topographic Morphing Array (***FPTMA***) with exceptional structural reconfiguration, field programmability, and function scalability for general-purpose lab-on-a-chip systems that beyond the reach of current state-of-art lab-on-chip systems. ***FPTMA*** can be software programmed to dynamically shape an elastic meta-interface from the initial smooth structure into desired time-varying topographic structures and thus generate spatiotemporal Topographic-Morphing-induced capillary forces to actively manipulate multi-droplets in parallel and enable real-time reconfiguring diverse microfluidic operations/functions/flow networks as well as workflows. We envision that the development of the ***FPTMA-driven*** lab-on-a-chip systems that leverage dynamic interfacial topographies to digitally handle microfluidics would significantly stimulate numerous technological innovations in biology/medicine/chemistry [1].

Keywords: Reconfigurable Microfluidics; Soft Actuators; Responsive Deformation; Lab on a Chip

References

[1] Yangyang Fan, Huimin Wu, Jiao Wang, and Jiu-an Lv*. Field Programmable Topographic-Morphing Array for General-Purpose Lab-on-a-Chip Systems. ***Adv. Mater.*** 2024, 2410604.