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INTERNATIONAL MICROFLUIDICS CONGRESS
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Chair in lab-on-a-chip technology, Canada

Visual or electrical sensing feedback assisted active control of droplets in microchannels towards automated, modular lab-on-a-chip platform

Droplet-based two-phase microfluidics enables high throughput screening analysis by utilizing monodispersed nanoliter-sized droplets as mobilized test tubes. Other advantages of droplet microfluidics over traditional high throughput technology include continuous flow offering continuous processing, minimized cross contamination benefiting from well encapsulated droplets, and rapid mixing due to three-dimensional flow occurring in droplets. At the core of each application are droplet manipulation techniques that include generating, splitting, merging, trapping and releasing of droplets. Most techniques rely on passively actuating the droplets through geometry which leads to errors due to manufacturing defects, operation uncertainties, and the highly coupled nature of the system. Active methods can circumvent such problems but most often at the cost of more complex manufacturing by embedding electrodes for instance. This talk presents an active droplet manipulation technique without the need of external forces or units to be integrated. This technique utilizes feedback (visual and electrical sensing) to assist in a microcontroller that regulates the applied pressures for flow control in microchannels. It basically takes advantage of passive techniques such as no external forces and units while eliminating their drawbacks as any uncertainties and variations are compensated for through the control system. Furthermore, active control with visual or electrical feedback allows multiplexing the capabilities of a simple geometry (i.e. T-junction) at which a droplet can be generated, split, merged, and immobilized repeatedly without increasing the complexity of channel network or device footprint. This talk will discuss fundamentals of this active control technique and present its applications

Activities justification:

As the leader of the active droplet control using visual imaging feedback direction within our research group, I prepared and submitted the documents to apply for provisional patents in the United States and Canada. The visual feedback assisted active droplet control technique is novel and new to the field of droplet microfluidics with a few studies reported in literature. It is envisioned that this technique would be widely adopted as a practically useful tool for applying droplet microfluidics for a wide range of applications. Attending the Gordon conference would allow me to discuss how our new microfluidic platform fits in the current state of microfluidics research, exchange ideas with other researchers for guiding the research direction and development and potentially establish collaboration so that this technique would facilitate the development of droplet microfluidics.

Biography

Carolyn Ren is a Professor in the Department of Mechanical and Mechatronics Engineering and a Tier 2 Canada Research Chair in lab-on-a-chip technology. She is also the Director of the Waterloo Microfluidics Laboratory and a fellow of the Canadian Society of Mechanical Engineers.

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