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Small is big: magic microfluidic droplets

Droplets of nanoliter and subnanoliter are useful in a wide range of applications, particularly when their size is uniform and controllable. Examples include biochemistry, biomedical engineering, food industry, pharmaceuticals, and material sciences. One example of their many fundamental medical applications is the therapeutic delivery system for delivering site-specific therapy to targeted organs in the body and as the carriers for newer therapeutic options. The size, the size distribution, the generation rate and the effective manipulation of droplets at a scale of nano, pico, femto and even atto liters are critical in all these applications. We make an overview of microfluidic droplet generation of either passive or active means and report a glass capillary microfluidic system for synthesizing precisely controlled monodisperse multiple emulsions and their applications in engineering materials, nanofluids, microfibers, embolic particles and colloidosome systems. Our review of passive approaches focuses on the characteristics and mechanisms of breakup modes of droplet generation occurring in microfluidic cross-flow, co-flow, flow-focusing, and step emulsification configurations. The review of active approaches covers

the state-of-the-art techniques employing either external forces from electrical, magnetic and centrifugal fields or methods of modifying intrinsic properties of flows or fluids such as velocity, viscosity, interfacial tension, channel wettability, and fluid density, with a focus on their implementations and actuation mechanisms. Also included is the contrast among different approaches of either passive or active nature.

Biography

Liqu Rick Wang received his PhD from University of Alberta, Canada and is currently a Full Professor in the Department of Mechanical Engineering, University of Hong Kong. He is also the Qianren Scholar (Zhejiang) and serves as Director and Chief Scientist for the Laboratory for Nanofluids and Thermal Engineering, Zhejiang Institute of Research and Innovation (HKU-ZIRI), University of Hong Kong. He was Visiting Professor at Harvard University (2008) and Duke University (2003). He has given over 45 invited plenary/keynote lectures at international conferences, and serves/served as the Editor-in-chief for the *Advances in Transport Phenomena*, the Editor for the *Scientific Reports*, the Associate Editor for the *Current Nanoscience* and the Guest Editor for the *Journal of Heat Transfer*.

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