第61回工学とバイオセミナー
Engineering in Medicine and Biology Seminar

Single-Phase Microfluidics for Protein Fractionation and Two-Phase Droplet Microfluidics for Biomedical Applications

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Microfluidics exploits fluids and their physical and chemical properties at the microscale, enabling miniaturized platforms that offer lower cost, faster pace, higher performance, and more portable options than traditional technologies. Protein fractionation which offers tremendous potential for drug screening has been one of the major challenges facing the fields of microfluidics and analytical chemistry. This talk will present a unique single-phase microfluidics-based free-flow counterflow gradient focusing technology that allows a large amount of a specific protein sample (mg vs. mg) to be purified and collected. Single-phase microfluidics has some inherent limitations including, but not limited to, slow mixing, cross-contamination and low throughput. These limitations have hampered their applicability to many biomedical areas. Two-phase droplet microfluidics emerged as a promising alternative to address these limitations. Droplet microfluidics employs monodispersed water-in-oil or oil-in-water droplets that can be generated at kHz rates in microchannels as mobilized test tubes for high throughput analysis. This talk will introduce passive and active droplet microfluidics research and their biomedical applications. First, a suite of physical models that can serve as design tools for passive-based droplet modules such as droplet generator, merger, sorter and heater will be presented. Then a unique active droplet microfluidics method that relies on visual feedback of droplet position to actuate a pressure source to actively control individual droplets realizing functional modules will be presented. Finally, their applications to drug screening, hemagglutination assay and organoids growth will be discussed.

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