TEXAS TECH UNIVERSITY
Department of Mechanical Engineering

Ph.D. Defense Announcement

Measuring mass of a single cell in an electromechanical force enhanced differentially polarized interface (DPI) digital microfluidics (DMF) platform

by

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Abstract

Characterizing the critical change in mass of a single healthy cell as compared to its unhealthy counterpart is of great interest for unraveling the causal mechanism of diseases. Currently, only three techniques have been reported for such measurements, which are suspended micro-channel resonators (SMR) sensors, quantitative phase imaging (QPI), and pedestal resonant sensors. Although these techniques provide good measurement sensitivity; fabrication complexity, loss of critical cell environment, and lack of efficiency prevent these platforms from using for critical characterization of cell physical properties. In this work, inspired by the pump less transport and controllability of discretized nano-pico droplet by digital microfluidics (DMF), a DMF platform is developed and the feasibility investigation of cell mass measurement in DMF is performed. Despite versatile applicability of DMF, current DMF platforms suffer from high voltage requirement for both DC (direct current) and AC, use of filler medium such as oil, and solution specific frequency tuning in AC. By differentially polarizing the solid–liquid interface (DPI), electromechanical force is enhanced in translating a droplet using the developed DMF. The experimental results presented in this work incorporating DPI distinguishes the contributions of electrowetting and electromechanical forces to the translation of droplets in digital microfluidics. This method significantly reduces the voltage required by DC-DMF in an air medium. Unlike conventional DMF using DC or AC, this method increases the functionality of DMF by eliminating the need for oil (required by DC), high voltage, and frequency tuning (required by AC), which facilitates high throughput cell mass measurement with maintaining critical cell environment.