Department of Mechanical Engineering
&
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Modeling, Fabrication and Application of New Active Microfluidic Mixing Device Based on Electrokinetic Flow Instability

Professor Lin Wu
Department of Mechanical Engineering, University of Nebraska-Lincoln

Microfluidic devices for controlling and manipulating fluids at micro/nanolitre volume have been widely applied in many scientific and industrial applications such as bio/chemical sensing, DNA sequencing, drug delivery, optical display and many other bio/chemical analysis systems. Compared with traditional devices, the miniaturized fluidic systems with characteristic dimensions ranging from millimeters to micrometers (so called microfluidics) offer key advantages of a portable device that integrates multiple laboratory processes onto a single chip (lab-on-a-chip or micrototal analysis systems). The ability to handle liquid samples at a micro/nanolitre volume not only reduces the consumption of reagents and the cost but also increases the sensitivity and efficiency of the device.

Rapid mixing of two initially segregated reagents is essential in many microfluidic systems targeted for use in biochemical sensing techniques, the study of biochemical processes such as protein folding, and the synthesizing of many biological and chemical products such as nucleic acids and drugs. Unfortunately, rapid mixing at the microscale imposes enormous challenges. This presentation will report our most recent effort to develop new microfluidic mixing devices based on electrokinetic flow instability for the rapid mixing of weakly conducting chemical/bio reagents with different conductivities in a microfluidic channel. Results from our linear hydrodynamic instability theory, direct numerical simulation, and fluorescence visualization of the mixing process in the fabricated microfluidic device will be discussed in details. Our theoretical, numerical and experimental results show that our goal to achieve a rapid mixing in microseconds within a mixing length less than 1mm is achievable after the device designs are optimized.

When time allows, I will report our recent modeling and simulation studies on the interaction phenomenon between a laser beam and a molecularly thin liquid layer on a substrate. The laser-liquid layer interaction phenomenon is important for the emerging heat-assisted magnetic recording technology.

Refreshments following
ME Conference Rm. – N105 SEC
3:30 PM