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Complex Electrokinetic/Electrohydrodynamic Flows in Microfluidic Applications

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ABSTRACT

Electrokinetic flow is leveraged in a variety of microfluidic systems, and is a key enabler of on-chip electrophoretic processes with chemical and bio-analytical applications. The electromechanical coupling of electric field and electrolyte solution in these applications may sometimes lead to novel flow behavior as well as complex electromigration patterns. In this work I will explore two related subjects: electrokinetic instability, and electrophoretic sample preconcentration methods.

Electrokinetic instability (EKI) widely occurs when a heterogeneous buffer is subject to strong applied electric fields. Although undesirable for on-chip assays where controlled sample management is required, EKI is also proposed as efficient means for rapid micro-mixing which is intrinsically difficult for low-Reynolds number, micro-scale flows. I will present analysis, simulations, experimental observations, as well as reduced modeling results on this topic.

For sample preconcentration methods, I will briefly discuss the on-going development in the theory and simulation of strongly nonlinear electrophoretic processes. I will use temperature gradient focusing (TGF) as an example, and discuss the general characteristics of this class of phenomena.

BIOGRAPHY

Hao Lin received his PhD in Mechanical Engineering from University of California, Berkeley in 2001 and his B.S. in Applied Mechanics from Peking University, Beijing, P.R. China. His research interests are Theoretical and Computational Fluid Mechanics, Micro and Nano-scale Flow and Transport, Electrokinetics and Electrohydrodynamics; Bio-analytical and Bio-fluid Systems.