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Center for Multiphase Flow Research and Education

Near-Wall Assembly of Suspended Colloidal Particles Driven by the Combination of Shear Flows and DC Electric Field

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Wednesday, March 25, 10:00 am, 2004 Black Engineering

Abstract

Near-wall dynamics of particles in a microchannel flow are of interest because they are usually detected and manipulated by surface-mounted sensors and actuators. Dilute (< 0.5 vol%) suspensions of fluorescent $0.5 \mu\text{m}$ particles within $\sim 1 \mu\text{m}$ of the wall were visualized in combined Poiseuille and electroosmotic flows through $\sim 30 \mu\text{m}$ deep channels. When the particles lag, or lead, the flow due to electrophoresis, the particles migrate towards, or away from, the channel centerline, respectively—as is the case for inertial migration.

Under certain conditions, the particles then assemble into concentrated streamwise “bands”, which exist only within a few μm of the wall and are periodic in the cross-stream direction. There is no theoretical explanation for this novel type of directed assembly, though we hypothesize that it may be due to an electrokinetic instability. Our observations suggest that band assembly consists of three stages: 1) particle accumulation; 2) band formation; and 3) steady-state. The number and concentration of near-wall particles appears to grow exponentially during the initial accumulation phase. Though poorly understood, this type of colloidal assembly is a continuous and scalable way to produce microscale structures.

Biography

Dr. Minami Yoda received her B. S. from Caltech, and her M. S. and Ph.D. degrees from Stanford University. Her research interests are in experimental fluid mechanics and optical diagnostic techniques. Her group has published more than 90 journal papers, and currently studies the dynamics and directed assembly of suspended colloidal particles, jet impingement cooling of high heat flux plasma-facing components, superresolution microscopy, and novel imaging techniques for latent fingerprints. Before joining Georgia Tech in 1995, she was a postdoctoral fellow at the Technical University of Berlin in Germany. She is Chair of the American Physical Society (APS) Division of Fluid Dynamics, a Fellow of ASME and APS, an Editor of *Fluid Dynamics Research*, and an Associate Editor of *Experiments in Fluids*.



Refreshments will be provided.

This seminar counts towards the ME 600 seminar requirement for Mechanical Engineering graduate students.

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