MECHANICAL & INDUSTRIAL ENGINEERING COLLOQUIUM: ME 794

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Particle transport along and across the streamlines in microfluidic devices

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Flow in microfluidic devices are usually regarded based on the consideration of Stokes flow condition. Inertial microfluidics, however, has recently gained attention for applications in particle separation and filtering. In this case, the transport of particles along and/or across the streamlines will determine the functionality of the device. In the first part of this talk, I will discuss the design and development of a microfluidic device for deterministic arraying of microparticles for point-of-care applications. For Stokes flow condition, design parameters can be selected based on flow field simulations, for a set of funnel-shaped elements that can capture and arrest particles at pre-determined locations. Experimental results, for the flow of micron-sized neutrally buoyant polystyrene particles, validate the performance of the proposed device. In the second part of the talk, the flow of neutrally-buoyant suspensions of particles around bluff bodies within microfluidic devices is discussed. Suspensions studied are composed of low-viscosity liquids and monodisperse particles of diameter d = 3, 7, or 15 μm at a constant solid volume concentration of $\phi = 0.084$ (8.4 volume %). At elevated Reynolds numbers (up to 500) and depending on the geometry, segregation of the particles and fluid in the recirculating wake region of bluff bodies are observed. Experimental evidence shows that as the relative size of the particle to the cross-stream dimension decreases, more particles cross the streamline at the boundary of the recirculating flow and enter the wake region. Possible applications will be discussed.

BIOGRAPHY

Dr. Shahab Shojaei-Zadeh received his PhD in 2008 from the department of mechanical engineering at Carnegie Mellon University. He then joined the Benjamin Levich Institute for Physico-Chemical Hydrodynamics at CCNY as the first Levich postdoctoral fellow where he established the Small Scale Fluid Mechanics Laboratory. He is currently an assistant professor of mechanical and aerospace engineering at Rutgers University. His research interests include complex fluids and soft matter physics with applications in biomedicine and energy storage systems.

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