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Tentative topic of the invited talk

Suppression of acoustic streaming to enable ultrasound-focusing of nanoparticles

Abstract of the invited talk

The conventional acoustophoretic ultrasound focusing of microparticles in pressure nodes typically fails for nanoparticles, because for particles with diameters less than 2 μm suspended in water and exposed to an ultrasound wave, the streaming-induced Stokes drag, that swirls the particles around, dominate over the acoustic radiation force that that focuses the particles. Four strategies are discussed of how to overcome this limitation and obtain ultrasound focusing of nanoparticles: (1) Suppression of the streaming vortices except one central one by phase-controlled wall-actuation. (2) Localization of the streaming vortices to narrow regions along the walls by using inhomogeneous carrier liquids. (3) Localization of streaming in small grooves along the channel walls by shape-optimization of the confining walls. (4) Supression of streaming by embedding the liquid-filled acoustofluidic channel in a metamaterial, whose coarse-grained elastic moduli are matched to the acoustic properties of the liquid to allow for nearly zero motion of the liquid relative to the walls. For these strategies to be of practical use in lab-on-a-chip technology, it is crucial to obtain a sufficiently high acoustic energy density in the resulting ultrasound fields, so that the resulting nanoparticle focusing times, which are inversely propotional to the square of the particle radius, are sufficiently short. The possibility of obtaining such a high acoustic energy density is discussed for each streaming suppression strategy.
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