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Theory of viscous corrections to the acoustic radiation force on a suspended microparticle in a standing ultrasound wave HENRIK BRUUS, MIKKEL SETTNES, Technical University of Denmark — We present a theoretical analysis of the acoustic radiation force causing acoustophoresis on suspended microparticles and cells in an standing ultrasound field of frequency ω. We include the kinematic viscosity ν of the solvent thereby extending the now classical and widely used theory by Gorkov valid only for inviscid solvents [1]. The viscosity appears through the formation of the incompressible viscous boundary layer of width a few times $\delta = \sqrt{2\nu/\omega}$ around the suspended particle. Previous analyses [2,3] of the dependence of δ had emphasis on developing general theoretical schemes and provided analytical expressions only in the limit $\delta \ll a \ll \lambda$. Our analysis does not have this limitation, and we take into account the incompressible boundary layer surrounding the particle and where viscosity dominates, and match the acoustic wave here with that in the compressible solvent where viscosity can be neglected. We apply our analytical result to calculate the values of the viscous corrections for particles of size and composition typically employed in microchannel acoustophoresis.

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