Discrete Simulation of Particle Separation in Microfluid due to SSAW

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Abstract: Particle manipulation due to SSAW has been spread widely in many lab-on-a-ship applications such as flow cytometry, single molecular detection, protein folding, cell sorting and enzymatic kinetics. For microflow, particle separation can be quite difficult, since the laminar nature of microfluidic flow predominantly determines the particle motion following the fixed streamlines. Thus the lateral forces are necessary to change the original path of particles, involving hydrodynamic force, electro-kinetic force, dielectrophoresis force and acoustic force. To date, the standing surface acoustic wave (SSAW) shows the unique abilities in separating particles in micro-channel. Based on particle size, density and shape, with proper application of SSAW, particle separation can be done meeting various demands. However, each single particle motion in microscopic level is not easy to be studied by experimental method and conventional continuum method, therefore, the discrete element method (DEM) plays irreplaceable role to study the particle separation phenomena with SSAW. In this paper, the polystyrene particles are described by DEM, the flow (water) is simulated by computational fluid dynamics (CFD). The acoustic force acted on each particle in implanted into DEM based on Gorkor theory. Based on the comparison with experimental results, CFD-DEM shows good accuracy in numerical study of particle separation with acoustic wave, along with the microscopic information of each single particle which is difficult to obtain either by experiments or continuum simulation.

DOI:10.32604/icces.2019.05495 www.techscience.com/icces