Modelling and Simulation of Microparticles Separation using Standing Surface Acoustic Waves (SSAWs) Microfluidic Devices for Biomedical Applications

International Journal of Computer Applications
Foundation of Computer Science (FCS), NY, USA

Volume 129

Number 9

Year of Publication: 2015

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Abstract

The design of significant and powerful standing surface acoustic wave (SSAW) microfluidic device for microparticles separation for biomedical applications is depending on the dimensions of microchannels for the collecting microparticles. For this purpose, precise calculations of the displacement of microparticles in the working area of SSAW microfluidic device are required. In this paper, the theory and principles of using SSAW microfluidic devices for particles separation are described. The almost published papers in this field had taken into account only the effect of SSAW and viscous drag forces, but the microparticles in the separation process can be affected by other forces. Therefore, the forces acting on the microparticles in fluid flow in SSAW microfluidic devices such as hydrodynamic and diffusion forces are analyzed by mathematical models. Also, the SSAW force is affected by Rayleigh angle, therefore, the SSAW force with the effect of Rayleigh angle which acting on the microparticles is analyzed by mathematical model. The simulation programs are also built by Matlab program to calculate the displacement of microparticles based on the effect of SSAW and viscous drag forces alone; and based on the effect of SSAW with Rayleigh angle effect, viscous drag, hydrodynamic, and diffusion forces.
Two types of microparticles different in size and two types of microparticles different in density are separately simulated to verify these programs and show the effects of this analysis. The analysis and simulation of these effects are positively led to more accurate calculations of the displacement of microparticles in the SSAW microfluidic device.

References


Index Terms

Computer Science  Biomedical
Keywords

Mathematical Models, Microfluidics, Microparticles Separation, Surface Acoustic Wave Devices.