

한 쌍의 2차원 반무한 사각전극이
유전성 유체에 작용하는 전기유체역학적 힘
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Electrohydrodynamic Force on a Dielectric Fluid by a Couple of 2-dimensional, Semi-infinite and Rectangular Electrodes

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Key Words: dielectrophoresis(유전영동), conformal mapping(등각사상), hydrostatic pressure(정수압), micropump(마이크로 펌프)

Abstract : When a couple of 2-dimensional, semi-infinite and rectangular electrodes is placed in a dielectric fluid and voltages applied to them are different, the electrohydrodynamic force acting on a dielectric fluid is analytically obtained. Since the physical domain is symmetric on the centerline and the applied potentials are anti-symmetric based on the mean value, the analysis on the half physical domain suffices for our purpose. The half domain can be conformally transformed to the infinite strip, where the Laplace equation on the electrical potential can be easily solved. When the results are applied to a micropump design, it can provide the body-force field and the hydrostatic pressure difference and help the optimal design of electrodes.

포스트가 배열된 마이크로 채널 내 전기 역학 및 유전 영동
흐름에 대한 수치 연구

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Numerical Studies on Electrokinesis and Dielectrophoresis in Microchannels with a Uniform Post Array

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Keywords: Electrokinesis(전기 역학), Dielectrophoresis(유전 영동), Streaming dielectrophoresis(흐름 유전 영동), Trapping dielectrophoresis(포획 유전 영동)

Abstract : We predict electrokinetic and dielectrophoretic flows in microchannels with a uniform post array. Computational studies are performed to determine particle velocities driven by electrokinesis and dielectrophoresis, and Monte Carlo simulations are conducted to visualize the particle motions. At low applied electric fields, electrokinesis and diffusion is the dominant transport mechanism. At moderate applied fields, dielectrophoresis become dominant over electrokinesis and diffusion to produce flowing filaments of concentrated and rarefied particles in the microchannel. At high applied fields, dielectrophoresis overwhelms and locally traps particles. These results provide useful insight for optimizing design parameters of a microfluidic chip to carry out on-chip sample pretreatment using electrokinetic and dielectrophoretic effects.