World Academy of Science, Engineering and Technology
International Journal of Biomedical and Biological Engineering
Vol:11, No:09, 2017

Modeling of Electrokinetic Mixing in Lab on Chip Microfluidic Devices

Authors : Virendra J. Majarikar, Harikrishnan N. Unni

Abstract : This paper sets to demonstrate a modeling of electrokinetic mixing employing electroosmotic stationary and time-dependent microchannel using alternate zeta patches on the lower surface of the micromixer in a lab on chip microfluidic device. Electroosmotic flow is amplified using different 2D and 3D model designs with alternate and geometric zeta potential values such as 25, 50, and 100 mV, respectively, to achieve high concentration mixing in the electrokinetically-driven microfluidic system. The enhancement of electrokinetic mixing is studied using Finite Element Modeling, and simulation workflow is accomplished with defined integral steps. It can be observed that the presence of alternate zeta patches can help inducing microvortex flows inside the channel, which in turn can improve mixing efficiency. Fluid flow and concentration fields are simulated by solving Navier-Stokes equation (implying Helmholtz-Smoluchowski slip velocity boundary condition) and Convection-Diffusion equation. The effect of the magnitude of zeta potential, the number of alternate zeta patches, etc. are analysed thoroughly. 2D simulation reveals that there is a cumulative increase in concentration mixing, whereas 3D simulation differs slightly with low zeta potential as that of the 2D model within the T-shaped micromixer for concentration 1 mol/m³ and 0 mol/m³, respectively. Moreover, 2D model results were compared with those of 3D to indicate the importance of the 3D model in a microfluidic design process.

Keywords : COMSOL Multiphysics®, electrokinetic, electroosmotic, microfluidics, zeta potential
Conference Title : ICMN 2017 : International Conference on Microfluidics and Nanofluidics
Conference Location : Tokyo, Japan
Conference Dates : September 07-08, 2017