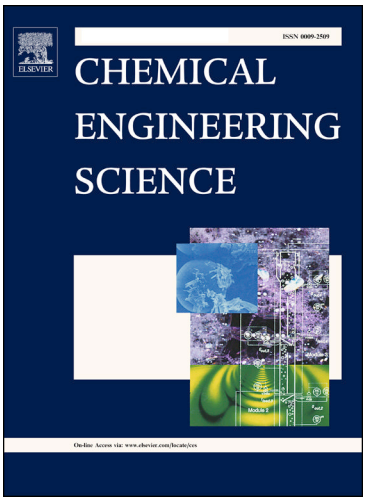

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Pulsatile electroosmotic flow in a microchannel with asymmetric wall zeta potentials and its effect on mass transport enhancement and mixing

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Abstract

In this work, we analyze theoretically the mass transport of a neutral solute in a pulsatile electroosmotic flow (PEOF), circulating in a parallel flat plate microchannel whose walls are characterized by asymmetric zeta potentials. The microchannel is connected to a two reservoirs having different concentrations. To analyze the mass transport in the PEOF, the Debye-Hückel approximation is assumed, and the electric potential in the Debye length is obtained from the Poisson-Boltzmann equation. Then, using the momentum and concentration equations, the flow and concentration fields are analytically determined for the periodic stage. Such field distributions depend principally on three dimensionless parameters: an angular Reynolds number, the Schmidt number, and the ratio between the half height of the channel and the Debye length. For obtaining insight on the physical aspects of the studied phenomenon, an asymptotic solution is additionally obtained in the limits of small and large values of the angular Reynolds number. Some important results derived from this analysis show the conditions for which the mass transport of a neutral solute can be enhanced and the circumstances whereby mixing of species is achieved.

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