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Electrokinetic Transport of Power Law Fluid through Hydrophobic Micro-Slits

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Abstract : Flow enhancement and species transport in a slit hydrophobic microchannel is studied for non-Newtonian fluids with the externally imposed electric field and pressure gradient. The incompressible Poisson-Nernst-Plank equations and the Navier-Stokes equations are approximated by lubrication theory to quantify the flow structure due to hydrophobic and hydrophilic surfaces. The analytical quantification of velocity and pressure of electroosmotic flow (EOF) is made with the numerical results due to the staggered grid based finite volume method for flow governing equations. The resistance force due to fluid friction and shear force along the surface are decreased by the hydrophobicity, enables the faster movement of fluid particles. The resulting flow enhancement factor Ef is increased with the low viscous fluid and provides maximum species transport. Also, the analytical comparison of EOF with pressure driven EOF justifies the flow enhancement due to hydrophobicity and shear impact on flow variation.

Keywords : electroosmotic flow, hydrophobic surface, power-law fluid, shear effect
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