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Numerical analysis for rotating electro-osmotic flow of fractional Maxwell fluids. (English)

Zbl 1450.76039
Appl. Math. Lett. 103, Article ID 106179, 8 p. (2020).

Summary: In this paper, a rotating electro-osmotic flow of a fractional Maxwell fluid in a parallel plate microchannel with high zeta potentials is examined. The Navier's slip law at walls is considered. The electric double layer potential distribution is derived by using the nonlinear Poisson-Boltzmann equation. Based on the $L1$ approximation of the Caputo derivative, a Crank-Nicolson numerical scheme is developed for obtaining the numerical solutions of the rotating electro-osmotic flow velocity profiles. With a purpose to verify the correctness of our numerical results, a comparison has been made with the analytical solutions of the Newtonian fluid given by the previous work, and the excellent agreement between the solutions is clear. Finally, the influence of the fractional parameters α and β, the slip length d and the wall zeta potential ζ on the velocity distribution is also discussed in detail.

MSC:

76U05 General theory of rotating fluids
76W05 Magnetohydrodynamics and electrohydrodynamics
76A10 Viscoelastic fluids
76M20 Finite difference methods applied to problems in fluid mechanics
26A33 Fractional derivatives and integrals

Keywords:

Crank-Nicolson finite difference scheme; slip boundary condition; high zeta potential; Canuto derivative; Poisson-Boltzmann equation

Full Text: DOI

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