EFFECT OF SOLVENT VISCOSITY ON ELECTRO-OSMOSIS FLOW OF VISCOELASTIC FLUIDS

A. Cavadas, A.M. Afonso, M.A. Alves, F.T. Pinho

Faculty of Engineering University of Porto, Portugal

adelioc@fe.up.pt

The theoretical study of electro-osmotic flows of non-Newtonian fluids is recent and is currently gaining momentum. Initially, it was directed to simple inelastic fluid models such as the power-law, due to inherent analytical difficulties introduced by more complex constitutive equations. Recently, the solutions for fully-developed electro-osmotic flows were extended to non-linear viscoelastic fluids, even when combined with pressure gradient forcing, as presented in the works of Afonso et al. *[J. Non-Newt. Fluid Mech*. **159** (2009) 50], Dhinakaran et al. [*J. Colloid Interf. Sci.* **344** (2010) 513] and Sousa et al. [*Microfluidics Nanofluidics*, DOI: 10.1007/s10404-010-0651-y].

In this work we investigate the electro-osmotic flow of a viscoelastic fluid between parallel plates under fully developed flow conditions. The rheology of the fluid is described by the Phan-Thien-Tanner and FENE-P models, including the solvent viscosity contribution. The nonlinear Poisson-Boltzmann equation governing the electrical double layer field and the body force generated by the applied electrical potential field are included in the analysis. Transverse profiles across the microchannel are presented for the velocity and stress components, with special attention given to the effects of the solvent viscosity ratio and flow Deborah number. Results of flow driven by electro-osmosis in combination may also be considered. Note that for pure electro-osmosis the solution is completely analytical, whereas for the mixed forcing the solution is only semi-analytical.