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A Computational Study of Viscoelastic Effects on Drop Dynamics in Microchannels[1] DAULET IZBASSAROV, METIN MURADOGLU, Department of Mechanical Engineering, Koc University Rumelifeneri Yolu, Sariyer 34450 Istanbul, Turkey — A front-tracking method is developed and applied to study effects of viscoelasticity on drop dynamics in microchannels. The FENE-CR and Oldroyd-B models are employed to model the viscoelasticity. The viscoelastic model equations are solved fully coupled with the flow equations. An explicit semi-analytical time integration scheme is used for the viscoelastic model equations at low Deborah numbers and a log-conformation is used to alleviate the well-known difficulties at high Deborah numbers. The log-conformation is found to be stable and very robust for a wide range of Deborah numbers. The method is first validated for the benchmark single-phase viscoelastic flow through an axisymmetric channel with a 4:1 constriction and the results are found to be in a good agreement with earlier computational simulations. The algorithm is then used to study fluid dynamics of buoyancy-driven viscoelastic two-phase systems in a capillary tube. Extensive computations are performed to examine the effects of confinement and rheological properties of the phases on drop mobility and deformation. Finally, the method is applied to study the motion and deformation of a viscoelastic droplet in a pressure driven axisymmetric contraction/expansion micro-channel. Key Words:Viscoelastic fluid,FENE model.

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