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Rheology of an emulsion of viscoelastic drops in steady shear
NISHITH AGGARWAL, KAUSIK SARKAR, University of Delaware — Rheology of dilute emulsions with viscoelastic inclusions in steady shear flow is numerically investigated using direct numerical simulations. A new mathematical formulation following Batchelor's work for purely viscous components is developed. Viscoelasticity is modeled using the Oldroyd-B constitutive equation. A front tracking finite difference code is used to numerically determine the drop shape, and solve for the velocity and stress fields. The effective stresses have three different components due to viscosity difference, interfacial tension and the drop phase viscoelasticity. The interfacial stresses—first and second normal stress differences and shear stresses—show behavior similar to a Newtonian emulsion. The normal stress difference due to the drop phase viscoelasticity is quadratic in shear rate and depends also on the relaxation time of the Oldroyd-B model. Drop phase viscoelasticity does not contribute significantly to effective shear viscosity of the emulsion.

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