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A viscoelastic drop falling through a viscous fluid MUKHERJEE SWARNAJAY, KAUSIK SARKAR, University of Delaware — A viscoelastic drop falling through a Newtonian medium is simulated using a front tracking finite difference method. The drop viscoelasticity deforms the drop into an oblate shape. Further increase in viscoelasticity forms a dimple at the rear end of the drop. The dimple is a result of viscoelastic stresses which pulls the drop interface towards the center. The dimple becomes increasingly prominent as Deborah number or the capillary number is increased. An approximate analysis is executed to model the stress development along the axis of symmetry, specifically its increase near the rear end that governs dimple formation. The model also suggests a shift of the maximum of the viscoelastic stresses toward the centre of the drop with increasing Deborah number. For even higher values of Deborah number, the interface cannot balance the viscoelastic stresses and the dimple grows to make the drop unstable. Unstable cases accompany a decrease in velocity because of the formation of a globular shape at the end of the dimple. This results in a sudden increase in the cross-sectional area of the drop and simultaneous decrease in the settling velocity. Finally, we determine the critical Deborah number for transition from stable to unstable cases for varying capillary number.

Kausik Sarkar
University of Delaware

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