Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Rheology of capsule suspension[1] PROSENJIT BAGCHI, Rutgers University, R. MURTHY KALLURI — Rheology of suspension of liquid-filled elastic capsules in linear shear flow is studied by three-dimensional numerical simulations using a front-tracking method. First, we consider dilute suspension capsules of spherical resting shape for which only a steady tank- treading motion is observed. We find a novel result that the capsule suspension exhibits a shear viscosity minimum at moderate values of the viscosity ratio, and high capillary numbers. The shear viscosity minimum exists for capsules with area-dilating membranes, but not for those with nearly-incompressible membranes. Physical mechanisms underlying these results are studied by decomposing the particle stress tensor into a contribution due to the elastic stresses in the capsule membrane, and a contribution due to the viscosity differences between the internal and suspending fluids. It is shown that the elastic contribution is shear-thinning, but the viscous contribution is shear-thickening. We then consider dilute suspension of oblate shape capsules which undergo unsteady motion such as swinging and tumbling. The effect of such unsteady dynamics on time-dependent rheology is addressed. Finally, we consider dense suspension, and observe that the shear viscosity minimum disappears with increasing capsule volume fraction.

[1]Funded by NSF grant no.CTS-0625936.

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Date submitted: 06 Aug 2010 Electronic form version 1.4