Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Inertial effects on the dynamics of a drop in a shear flow and the dispersed stresses RAJESH SINGH, KAUSIK SARKAR, University of Delaware — We numerically simulate the flow field and the streamlines around a drop in shear using a front tracking finite difference method. Inertia destroys the closed streamlines found in a Stokes flow, and gives rise to spiraling and reversed streamlines. Orientation angle of the drop increases with inertia and becomes larger than 45 degrees with increasing inertia at low capillary numbers. However, at higher capillary numbers, it becomes nonmonotonic–it first increases with Reynolds number and then decreases as the drop deformation becomes large. Inertia also introduces transient overshoot and oscillation in the drop deformation before it achieves a steady shape. We provide a simple model for the oscillation that shows the correct scaling with Reynolds and capillary numbers. We also investigate the interfacial tensor that determines the dispersed stress in an emulsion of such drops. We show that the higher than 45 degree inclination leads to a change in sign of the dispersed normal stress differences. The effects of viscosity ratio on the streamline pattern around a drop are also studied.

Kausik Sarkar
University of Delaware

Date submitted: 04 Aug 2010 Electronic form version 1.4