Meeting: 1005, Newark, Delaware, SS 7A, Special Session on Frontiers on Complex Fluid Flows: Analytic and Computational Methods

1005-76-124 **Satish Kumar*** (kumar@cems.umn.edu), Dept. of Chem. Eng. and Mat. Sci., 151 Amundson Hall, 421 Washington Ave. SE, Minneapolis, MN 55455. *Flow Instabilities near Polymer Gels: Linear and Nonlinear Behavior.*

Fluid flows near polymer gels are prone to instabilities that bear many resemblances to those encountered in viscoelastic fluid mechanics. In addition to being of potential importance to practical applications such as microfluidics and polymer processing, study of such instabilities may also yield insight into the behavior of fluids that undergo flow-induced gelation such as worm-like micelle solutions. In order to understand the role that nonlinear rheological properties of the gel play in these elastohydrodynamic instabilities, we apply linear stability analysis to investigate creeping Couette and Poiseuille flows of Newtonian and viscoelastic fluids past an incompressible and impermeable neo-Hookean solid of finite thickness. Experiments in a parallel-plate rheometer with PDMS gels and a viscous Newtonian liquid shed light on instability behavior in the nonlinear regime. The stability analysis reveals that the first normal stress difference in the solid gives rise to a shortwave instability which is not present if a linear elastic model is used. The underlying mechanisms are probed by interrogating the interfacial boundary conditions. The experiments suggest that the instability is subcritical and leads to a flow that is oscillatory and far from viscometric. (Received February 03, 2005)