Rheology and Microrheology in Worm-Like Micelles.

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We have studied the rheology and microrheology behavior of a microemulsion made of hexadecyltrimethylammonium bromide (CTAB), sodium salicylate (NaSal), and water, which forms very long and flexible, cylindrical worm-like micelles. The viscoelastic behavior of this mixture depends on the CTAB molar concentration, the molecular ratio between CTAB and NaSal, [NaSal]/[CTAB], and the temperature. The mixture under shear presents shear thinning and strain hardening behavior. In a shear stress-shear rate diagram, at low shear rates, the mixture is Newtonian, and after a transition point there is a regime with almost constant shear stress, accompanied by a non-homogeneous change in the birefringence. In many cases, the transition from the Newtonian regime to the stress plateau depends of the flow history, and memory effects were observed. For R,d2, the transition from both regimes is continuous, and the birefringence change is homogeneous. We have probed the viscoelastic properties of the mixture with a light scattering technique (diffusion wave spectroscopy), through measuring the average motion of microspheres dispersed in the microemulsion. We obtained $G'(w)$ and $G''(w)$ prior to obtaining the mean square displacement of the microspheres, and these show that the microemulsion is a Maxwellian fluid at low frequencies. We obtained a Cole-Cole diagram and the Maxwell fluid's constants. The whole rheological behavior of this mixture has been discussed in terms of a non-equilibrium phase transition.