Spatio-temporal Chaotic Dynamics in the Flow of Soft Matter

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Abstract

The nonlinear flow behaviour of a viscoelastic gel formed due to the entangled cylindrical wormlike micelles of surfactant cetyltrimethylammonium tosylate (CTAT) shows rheochaos [1, 2]: for a suitable range of concentrations and temperatures, the stress vs. shear rate curve shows a plateau signaling a rheological phase coexistence. In the plateau region, the time series of the shear stress at a constant shear rate shows deterministic chaos. Recently [3], we have shown experimentally the route to chaos is via intermittency in CTAT gels where the strength of the flow-concentration coupling is tuned. The coupling of flow to concentration fluctuations is evidenced by the "Butterfly" intensity pattern in Small Angle Light Scattering (SALS) measurements performed simultaneously with the rheological measurements. The route to chaos depends on the control parameter. Most importantly, direct visualization of the gap of the Couette cell during shear rate/stress relaxation measurements shows that the spatio-temporal dynamics of the high shear rate band is closely related to the temporal shear rate/stress fluctuations [4].

References

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