

Complex Fluids with Memory

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We describe some of the current research and potential directions for complex fluids possessing memory. These are viscoelastic fluids that possess both elastic as well as liquid properties arising from a complex microstructure. They have an ever increasing number of applications in the mineral, oil, chemical, cosmetics, plastics and food industries. A hierarchy of macroscopic constitutive models will be covered together with their important properties in different flow regimes and high elastic limits. Classification of their behaviours at singularities will be given for corner and stick-slip (solid-free-surface) flows which are of relevance to industrial expansion/contraction and extrusion processes. The analysis makes use of a powerful formulation of the constitutive equations using a stress basis aligned with the flow (termed the natural stress basis). Current focus is the use of such a basis for numerical schemes. Issues of existence theory and the different molecular theories giving rise to macroscopic models will also be touched upon.