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Non-Newtonian Fluid Mechanics Using Molecular Theory

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Many natural and synthetic fluids are viscoelastic materials, in the sense that the stress endured by a macroscopic fluid element depends upon the history of the deformation experienced by that element. Notable examples include polymer solutions and melts, liquid crystalline polymers, and fibre suspensions. The remarkable rheological properties of viscoelastic liquids cannot be described by the Navier–Stokes equations, but rather are governed by the flow-induced evolution of molecular configurations. In the present lecture, I survey the field of multiscale simulation of viscoelastic flow using molecular models, and present recent results based on tube theory of linear entangled polymers. The talk will be of a general nature so that it is (hopefully) both understandable and useful for colleagues and students working on other topics in theoretical and applied mechanics.

View the extended summary