Abstract Submitted
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Modeling and simulating transient flows of thixotropic and viscoelastic fluids in microfluidic tubes[1] SOHAM JARIWALA, TIM VAN DE VYVER, NORMAN WAGNER, ANTONY BERIS, University of Delaware — An efficient methodology is developed for numerical simulation of flows in tubular geometries using a pseudo-spectral method based on Chebyshev basis. The proposed basis minimizes the truncation error as one can reach machine precision in fewer terms when the solution is expressed as an expansion of Chebyshev polynomials. The model follows, with high fidelity, the analytical solution of Newtonian and Maxwell fluids in oscillatory pressure-driven flows. The methodology can be useful in simulating highly non-linear velocity and shear stress profiles observed during transient flows of complex fluids in microchannels with arbitrary pressure forcing. This is demonstrated using existing elasto-viscoplastic fluid models, such as the one derived by Stephanou and Georgiou (J. Chem. Phys. 149, 244902, 2018) for thixotropic systems from non-equilibrium thermodynamics. The time and shear history dependence as well as the flow induced breakdown and buildup of the fluid microstructure is captured in a scalar field variable.

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