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**Designing with non-linear viscoelastic fluids** JONATHON SCHUH, YONG HOON LEE, JAMES ALLISON, RANDY EWOLDT, University of Illinois at Urbana-Champaign — Material design is typically limited to hard materials or simple fluids; however, design with more complex materials can provide ways to enhance performance. Using the Criminale-Ericksen-Filbey (CEF) constitutive model in the thin film lubrication limit, we derive a modified Reynolds Equation (based on asymptotic analysis) that includes shear thinning, first normal stress, and terminal regime viscoelastic effects. This allows for designing non-linear viscoelastic fluids in thin-film creeping flow scenarios, i.e. optimizing the shape of rheological material properties to achieve different design objectives. We solve the modified Reynolds equation using the pseudo-spectral method, and describe a case study in full-film lubricated sliding where optimal fluid properties are identified. These material-agnostic property targets can then guide formulation of complex fluids which may use polymeric, colloidal, or other creative approaches to achieve the desired non-Newtonian properties.

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