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Using the parallel plates geometry for nonlinear rheological measurements ZAHRA FAHIMI, Institute for Complex Molecular Systems and Department of Mechanical Engineering, Eindhoven University of Technology, 5600 MB Ein, The Netherlands, CHASE P. BROEDERSZ, Lewis-Sigler Institute for Integrative Genomics and the Department of Physics, Princeton University, Princeton, NJ 08544, USA, HANS M. WYSS, Institute for Complex Molecular Systems and Department of Mechanical Engineering, Eindhoven University of Technology, 5600 MB Ein, The Netherlands — Conventional wisdom dictates that studying the mechanical response of viscoelastic materials in the nonlinear regime should be done either with a cone-plate or a Couette geometry, where the applied strain is homogenous in the measuring volume. However, the use of parallel plates would have important advantages in a wide range of applications. For instance solid-like hydrogel materials can often be processed readily into flat films. We show that the nonlinear viscoelastic behavior can also be obtained from measurements in a parallel plate geometry. By tracing the torque response and its derivative with respect to the applied strain, we obtain a general stress strain relation, which indeed captures the proper material behavior. The approach does not require any assumptions for the material's viscoelastic behavior. We show practical examples different classes of soft materials to illustrate that our approach enables access to the full nonlinear response of these materials, including the detailed shape of the stress response in large amplitude oscillatory shear measurements. Our approach should be applicable to a wide range of soft materials, including hydrogels, colloidal suspensions, or biological tissues.

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