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**Fluid Dynamics and Rupture of Polymeric Solutions at Ultra-High Strain Rates** VLADIMIR MITKIN, UCSB, ALEXEY ROZHKOV, THEO THEOFANOUS, UCSB — We create inertially-driven, nearly free, expanding rings to access rheology and flow phenomena of polymeric solutions at ultra-high strain rates. For a given fluid, with increasing initial velocity, three regimes are identified: expansion followed by elastic rebound, steady expansion, expansion interrupted by ruptures (cohesiveness failure). From expansion histories we deduce rheology (relaxation time and elasticity modulus) in the frame of the Oldroyd B model, and show that regime transitions can be captured consistently over a wide range of fluid constitutions by a single dimensionless group; that is the product of the Deborah number and an elasticity number—the elasticity modulus scaled by the initial flow kinetic energy. Moreover in this manner we find that: (a) the onset of rupture is determined by a specific value of tension (a critical rupture stress) which is characteristic on the solvent-polymer involved, and (b) the critical rupture stress scales in proportion to polymer concentration just as is the elasticity modulus. The method and results complement low strain-rate rheology, as in the well-known filament-thinning method, and is particularly well-suited for informing the micromechanics of rupture at high strain rates.

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