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Probing the molecular microstructure of polymeric fluids with semi-dilute DNA solutions GABRIEL JUAREZ, University of Illinois, PAULO E. ARRATIA, University of Pennsylvania — We present experimental results on semi-dilute viscous DNA solutions undergoing planar extensional flow in microfluidic cross-slot devices. Bulk flow characterization shows that low molecular weight (MW) DNA solutions behave similar to a Newtonian fluid while high MW DNA solutions behave similar to a viscoelastic fluid and exhibit a symmetry-breaking flow instability. High-speed epifluorescent microscopy shows that DNA molecules approach the central stagnation point pre-stretched and aligned with the flow direction. At large strain rates compared to the polymer relaxation time, elongated molecules are rapidly compressed, leading to folded and kinked molecular states. This alternating stretch-coil to coil-stretch transition of buckled molecules yields scission of partially extended molecules. Semi-dilute DNA solutions provide a useful model system for further investigation of the molecular origin of viscoelastic instabilities.

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