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Polymer relaxation and stretching dynamics in semi-dilute DNA solutions: a single molecule study[1] KAI-WEN HSIAO, Graduate student at University of Illinois at Urbana Champaign, CHRISTOPHER BROCKMAN, Intel, CHARLES SCHROEDER, Associate professor at University of Illinois at Urbana Champaign — In this work, we study polymer relaxation and stretching dynamics in semi-dilute DNA solutions using single molecule techniques. Using this approach, we uncover a unique scaling relation for longest polymer relaxation time that falls in the crossover regime described by semi-flexible polymer solutions, which is distinct from truly flexible polymer chains. In addition, we performed a series of step-strain experiments on single polymers in semi-dilute solutions in planar extensional flow using an automated microfluidic trap. In this way, we are able to precisely control the flow strength and the amount of strain applied to single polymer chains, thereby enabling direct observation of the full stretching and relaxation process in semi-dilute solutions during transient start-up and flow cessation. Interestingly, we observe polymer individualism in the conformation of single chains in semi-dilute solutions, which to our knowledge has not yet been observed. In addition, we observe the relaxation data can be explained by a multi-exponential decay process after flow cessation in semi-dilute solutions. Overall, our work reports key advance in non-dilute polymer systems from a molecular perspective via direct observation of dynamics in strong flows.

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