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Dynamics of Knot Relaxation in Stretched DNA[1] ALEXANDER KLOTZ, VIVEK NARSIMHAN, BEATRICE SOH, PATRICK DOYLE, MIT —

Knots occur naturally in biological DNA and have been shown to be relevant for next-generation sequencing applications. Knots and other topological constraints in bulk polymer systems have been shown to influence the overall dynamical behavior of aggregate materials, but it is an open question as to the role that individual knots play in polymer dynamics. Here, we investigated the dynamics of polymer knot relaxation by stretching knotted DNA with an extensional field in a microfluidic device and allowing it to relax to its coiled state, measuring the growth rate of the knot using fluorescence microscopy. We find that knots swell during relaxation with a timescale comparable to that of the end-to-end relaxation. The knot growth timescale in insensitive to differences in the perceived topological complexity of the knot and increases with polymer chain length with the same scaling as the end-to-end relaxation timescale. These findings suggest that the timescale governing the swelling of knots in initially stretched chains is subject to global rather than local polymer dynamics.

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