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Structure Formation in Semi-Dilute Polymer Solution during Electrospinning EYAL ZUSSMAN, YAKOV PALEY, ARKADII ARINSTEIN, KIM SHUSTER, Department of Mechanical Engineering, Technion-Israel Institute of Technology — In our recent work it was shown that longitudinal stretching of electrospun highly entangled semi-dilute polymer solution caused by jet hydrodynamic forces, transforms the topological network to an almost fully-stretched state within less than 1 mm from the jet start (PRE, 2011). Further evolution of the polymer network is related to a disentanglement of polymer chains and transformation of the topological network structure. As was sown by Malkin et al., (Rheol. Acta, 2011) high deformation rate of a topological polymer network, results in reptations of macromolecules caused by uncompensated local forces, whereas Brownian motion effect is negligible. Based on this conclusion, we examine the disentanglement process, using a mechanical pulley-block system assembled from multiple pulleys suspended by elastic springs, and taut string connecting two blocks. Each pulley corresponds to a topological knot; the taut string corresponds to a reptated chain; the springs correspond to surrounded polymer chains; and the blocks correspond to local deformation force. It turned out that the system is sensitive to system parameters. The pulleys can approach each other and the string stops to move. Such a behavior corresponds to formation of bundle of knots of entangled chains. In other conditions, the string continuously moves while the pulleys did not approach each other which corresponds to disentanglement of polymer chains. These experiments clarify the disentanglement kinetics in rapid-deformed polymer system.

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