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Polymer Physics Prize Talk: Topological Constraints Matter – or Back to the Origin¹

KURT KREMER, Max Planck Institute for Polymer Research, Mainz, Germany

Topological constraints, being permanent or temporal, influence many properties of soft matter, especially polymers. While at a first glance the simple Rouse model describes the motion of short chains surprisingly well, the fact that chains cannot cut through each other dominates the dynamics of long chain melts, ring polymers and the relaxation in networks and gels. Furthermore new phenomena in special melts and mixtures even make this more obvious. The talk will review some developments and will also address new problems linked to material science as well as biology. To illustrate the importance of topological constraints, numerical simulations for a melt of non concatenated ring polymers with and without linear contaminants will be presented. While the static properties of long rings can be rationalized by the concept of a crumpled globule, dynamic properties are much less understood. Our simulations clearly show that diffusion and stress relaxation in such a system of globules decouple. In addition the first results for non concatenated rings added to a melt of linear polymers and for a few linear polymers added to a melt of rings will be discussed.

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