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Hopping Diffusion of Nanoparticles in Polymer Solutions: Non-Gaussian Stochastic Nature and Typical Timescale[1] XU ZHENG, CHUNDONG XUE, GUOQING HU, State key laboratory of nonlinear mechanics, Institute of Mechanics, CAS — The diffusion of nanoparticles (NPs) in crowded and heterogeneous environments is intriguing as it presents the mesoscopic behavior distinct from the classical Brownian motion. It is of great interest to explore how NPs are able to hop through such crowded networks. In this study, we present experimental results to demonstrate the occurrence of hopping diffusion and characterize the typical timescale of hopping dynamics in entangled polymer solutions. Current experiments focus on the hopping behavior of large NPs subjected to the constraint in entangled polymer solutions. Thus, we clarify the non-Gaussian stochastic nature and the time-varied tendency of the hopping dynamics in polymer solutions. We establish a scaling law of the hopping time scale τ_{hop}. The time-varied non-Gaussianity reveals the prevalence of the competition among the short-time relaxation of polymer entanglement strand, the hopping dynamics, and the long-time reptation. The hopping motion of large NPs in entangled polymer solutions occurs only when τ_{hop} is larger than the entanglement timescale but smaller than the reptation timescale, and it is attributed to the thermally activated process by overcoming the free energy barrier.

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