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Confinement-induced partial screening of intra-chain hydrodynamic interactions[1] YENG-LONG CHEN, JEN-FANG CHANG, PO-KENG LIN, Institute of Physics, Academia Sinica — In studies of polymer dynamics in a confined environment, one of the most commonly invoked assumptions is that intra-chain hydrodynamic interactions are completely screened when the confinement length is smaller than the polymer radius of gyration (Rg). However, recent experiments of single DNA molecules confined in nanoslits have observed that chain diffusivity (D) dependence on slit height (H) does not follow the Rouse scaling exponent of 2/3. Rather, the scaling exponent is found to be around 0.5 for Lk $<$ H $<$ Rg, where Lk is the DNA Kuhn length. This suggests that intra-chain hydrodynamic interactions are not completely screened. In this work, we carried out experiments and complementary simulations to characterize the effect of screening on polymer dynamics. To model the polymer dynamics, we employ a method of Brownian dynamics, combined with the lattice Boltzmann method, to simulate polymer dynamics confined in nanochannels. We find that hydrodynamic screening occurs gradually as the channel height decreases, and also that complete screening in H $<$ Lk channels leads to topological independence of chain diffusivity.

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