Real-time observation of single polymer chain dynamics in liquid phase

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Soft materials easily respond to external stimuli such as thermal energy, and their structure and dynamics change significantly depending on the surrounding environment. Their wide variety of three-dimensional structures are closely related to functions and properties, thus elucidating their structure and understanding their complex dynamics in liquid media are important to uncover the dynamic heterogeneity and molecular individualism governing macroscopic characteristics. Herein, we investigate the nanoscale dynamics and morphological changes of single linear polymer, employing *in situ* TEM with graphene liquid cell. For high-contrast TEM observations, dendronized polymers with electron-rich pendant groups are prepared and the molecular conformations of linear polymer chains in a good solvent are successfully visualized for the first time. We analyze sub-diffusive behavior, multiple loop formation, and interactive motions in gas-liquid interfaces at the single chain level. Our results can provide insights into understanding nature or complex biological processes at the nanoscale.