SINGLE POLYMER DYNAMICS IN A RANDOM FLOW

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ABSTRACT

Dynamics and conformations of single polymer molecules in various flows form the basis for our understanding of hydrodynamics of dilute polymer solutions and have remained an outstanding problem in polymer physics for several decades [1]. It is also directly related to the occurrence of drag reduction in turbulent flows. Here we presented the dynamics and conformations of a single fluorescently stained T4DNA molecule in a random flow of elastic turbulence, created by the same unlabeled molecules [2, 3]. The criterion of the coil-stretch transition was found to be close to the theoretically predicted value. Using measured polymer stretching statistics and its known elastic properties, the elastic stress in elastic turbulence is obtained for the first time as a function of a rotation speed and polymer concentration in water-saccharose solvents. It is found that the value of elastic stress is by at least two orders of magnitude larger than theoretically predicted that disproves the existing theory of elastic turbulence, and the normalized elastic stress in the elastic turbulence regime linearly depends on the local Weissenberg number, which defines the polymer stretching, for all used polymer concentrations and saturates at its highest values. The role of increasing shear rate on polymer extension and angular statistics in a random flow is also discussed.

Acknowledgement: This work is partially supported by the grants of the MPG-CAS Partner Group Program, the National Natural Science Foundation of China (21274147), and the Natural Science Foundation of Jilin Province, China (201215093).

References:

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