AN INHOMOGENEOUS KINETIC MODEL OF LIQUID CRYSTAL POLYMERS AND ITS THERMODYNAMIC CLOSURE APPROXIMATION

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ABSTRACT

A general inhomogeneous extension of the Doi's kinetic theory [1] with translational diffusion and non-local potential is proposed to describe the micro-structure and defect dynamics of Liquid Crystal Polymer solutions. The anisotropic long-range elasticity of polymer molecules is depicted by a non-local intermolecular potential with an integral kernel. A second-order moment model for isotropic long-range elasticity and a fourth-order moment model for anisotropic long-range elasticity which keep the energy dissipation of the exact kinetic model are obtained by applying quasi-equilibrium closure approximation [5]. Implemented by the invariant-based fitting method, the reduced moment models provide decent tools for numerical simulations of defect dynamics and texture evolution in LCP solutions. The numerical result of 1D in-plane rotational case and out-of plane rotational case shows that the reduced second-order moment model is capable to predict some complicated inhomogeneous director dynamics, but it is not quantitatively accurate. We suggest to use high order moment models, such as the fourth-order moment model presented in this manuscript, to get more accurate results for general inhomogeneous simulations.

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