Mesoscopic Domain Theory for Textured Liquid Crystals

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The director of liquid crystalline polymers at rest is not constant and varies from place to place; to form a spatial pattern called "textures". The texture is considered to be responsible for the peculiar rheological properties of the liquid crystalline polymers such as the damped oscillation in stress and dichroism when the rate of shear or its direction is suddenly changed and the gradual change of the moduli G' and G" after cessation of shear.

Here we present a semi-phenomenological theory which describes the dynamics of such textures[1]. In this theory the Leslie -Ericksen equations are assumed to each domains. These equations are averaged over spatial region large compared to a single domain. Phenomenologial equations are postulated to account for the elastic stress arising from the spatial variation of the directors. This gives a set of coupled equations for the domain size and the mesoscopic orietation and stress tensor.

The equation involves no intrinsic time constant and predicts a scaling relation for rheological response with different shear rate. This is analogous to our previous theory for the mixture of immiscible liquids with complex interfaces[2]

[1] R.G. Larson and M. Doi J. Rheology 35 539 (1991)

[2] M. Doi and T. Ohta J. Chem. Phys. to be published.