

Formation and dynamics of easy orientation axis in magnetic field on PVCN-F surface

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We describe the experiments on a magnetically-induced drift of the easy axis on a soft surface of photoaligning material fluoro-polyvinyl-cinnamate. We found unexpected partial relaxation of the drift of the easy axis after switching the magnetic field off. This relaxation cannot be explained in a framework of the existing models and requires additional assumptions about the drift process. We propose a model that explains the experimental data suggesting elastic-like behaviour of the polymer fragments during the drift of the easy axis.

Keywords: liquid crystal, easy axis, gliding, drift of easy axis, photoalignment.

1. Introduction

Traditional description of reorientation of a LC director in electric or magnetic field assumes a fixed position of the easy orientation axis \vec{e} on the aligning surfaces of a cell [1]. At the same time, field-induced deviation of the director \vec{d} near the surfaces from the direction \vec{e} due to a finite anchoring may result in a gradual drift of the easy axis out of its initial position (so-called, gliding effect) [28]. The adsorption/desorption of LC molecules on/from the aligning surface and cooperative reorientation of polymer fragments and LC molecules are considered as possible mechanisms of a gliding effect. The adsorption/desorption (AD) mechanism was proposed by Vetter *et al.* [2] for description of the gliding effect on polyvinyl-alcohol surface (in our knowledge it was the first observation of the drift of an easy axis). According to Vetter, drift of the easy axis is caused by rotation of the symmetry axes of the distribution function of the adsorbed LC molecules under the influence of a reorientation torque. It is suggested that the adsorbed molecules are oriented preferably along the initial direction of director in the cell. Application of the torque reorients the director nearby the surface that leads to the adsorption of molecules along this new direction. As a consequence, the symmetry axes of the angular distribution function of the adsorbed molecules reorients as well as the associated easy axis.

The model of cooperative reorientation of the director and polymer fragments was proposed first by Kurioz *et al.* [5] for explanation of unexpectedly slow relaxation of the director in the zenithal plane after application of electric

field to the cell with a soft polymer surface. It was suggested that due to the weak anchoring, the electric field reorients the director on the polymer surface, which, in turn, drags the flexible polymer fragments. As a result, electric field orients both LC molecules and flexible fragments in the direction that results in a drift of the easy axis. Later on, Janossy [6] explained the drift of the easy axis in the azimuthal plane over a soft polymer surface in a similar way. His interpretation of the azimuthal gliding is based on the assumption that the polymer main chains can undergo conformational transitions under the influence of the anisotropic potential of the liquid crystal. The change of the director position at the surface initiates conformational changes in the polymer and as a result, the easy axis rotates towards the director. This rotation decreases the anchoring torque and the director can rotate further towards the external field, resulting in the drift of the easy axis. The cooperative model is supported by the fact that the drift of the easy axis speeds up when the temperature of glass-like transition in the polymer is approached.

The microscopic description of the gliding effect in the terms of the rotation of the angular distribution function of the LC molecules adsorbed on the surface was developed in Refs. 7 and 8. It should be noted that both, the model of the adsorption/desorption and the cooperative model are described by the same equations in the approach of Refs. 7 and 8 and the difference is just in the physical meaning of these equations and values of microscopic parameters. The situation gets even more complicated since a drift of the easy axis can be observed both on rigid inorganic surfaces [4] with no flexible surface fragments and on soft polymer surfaces. One can suggest that the only adsorption/desorption mechanism governs the drift of the easy axis on the

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