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sciforum-094334: Modeling the Kinetics of auto-Oscillations in a Nematic Liquid Crystal Cell with Photoaligning in an azo-dye Layer on a Substrate

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Azo-dye layers have shown great promise due to the possibility of obtaining noncontact photoalignment layers of high quality. In this study, we investigate a structure that consists of a nematic liquid crystal (NLC) cell, in which one of the substrates is covered with a photosensitive azo-dye layer. The NLC has an initial planar director orientation. The linearly polarized light falls normally on the surface of the cell and propagates through the liquid crystal, reaching the azo-dye layer and interacting with it. The interaction of the light with the azo-dye leads to reorientation of the molecules of the azo-dye perpendicular to the light polarization. This changes the boundary condition for the NLC director and can result in its reorientation to a twisted state. Considering the NLC cell parameters that facilitate the Mauguin regime, the same photoalignment mechanism then kicks in in a perpendicular direction, leading to oscillations of the boundary conditions for the director and of the NLC director profile.

The dynamics of the NLC director reorientation is modeled using the free energy formalism, and the reorientation of the azo-dye molecules is modeled within the 2D Brownian orientation diffusion model. It was established that when the incident light intensity reaches a threshold value, the induced photo-alignment of the azo-dye becomes sufficient to start the NLC director reorientation toward a $\pi/2$ twist state. The threshold intensity increases with the Frank elastic constant and decreases with the anchoring energy. An increase in the light intensity and the azo-dye intermolecular interaction coefficient and the decrease in the viscosity of the NLC director lead to faster transitions between states and a lower period of oscillations.

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