Modeling of kinetics of photoinduced ordering in azo-dye films

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We theoretically study the kinetics of photoinduced ordering in azo-dye photoaligning layers and present the results of modeling performed using two different phenomenological approaches. A phenomenological two-state model is deduced from the master equation for the one-particle distribution functions of an ensemble of two-level molecular systems by specifying the angular redistribution probabilities and by expressing the order parameter correlation functions in terms of the order parameter tensor [1].

Using an alternative approach that describes light induced reorientation of azo-dye molecules in terms of the rotational Brownian motion [2], we formulate the two-dimensional diffusion model as the free energy Fokker-Planck equation simplified for the limiting regime of purely in-plane reorientation. The models are employed to interpret the irradiation time dependence of the absorption order parameters defined in terms of the principal extinction coefficients.

Using the exact solution to the light transmission problem for a biaxially anisotropic absorbing layer, these coefficients are extracted from the absorbance-vs-incidence angle curves measured at different irradiation doses for the probe light linearly polarized parallel and perpendicular to the plane of incidence. In the azo-dye films, the transient photoinduced structures are found to be biaxially anisotropic whereas the photosteady and the initial states are uniaxial.

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References

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