Light-induced surface mass-transfer phenomena in photochromic LC polymer systems.
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Among the numerous new liquid crystalline (LC) polymers studied in the past decades photochromic LC polymer systems constitute the most important segment in polymer science associated with creation of smart materials capable of being highly sensitive to the light irradiation. Photoinduced mass-transfer phenomena in such materials attract a great attention due to the promising potential for application in holography, optoelectronics, nanodevices, etc. Our attention is focused on the photooptical investigations of photochromic LC polymer systems and, in particular, on the photoinduced mass-transfer processes.

The first part of the talk is devoted to the AFM study of laser induced surface deformation and crater (holes) formation in LC azobenzene-containing photochromic polymer systems. Special set up including combination of polarizing optical, atomic force microscopies and a possibility of irradiation with a highly focused laser beam (532 nm) was used for these investigations. Films of the nematic azobenzene-containing polyacrylate PA and the cholesteric mixture prepared by doping of PA with the chiral dopant Sorb were investigated. Focused laser beam irradiation results in the crater formation formed due to a mass-transfer outside center of beam (Fig. 1).

Depth of these craters lies in the range of tens nanometers and increases by irradiation time prolongation. It is found that this phenomenon takes place only for thick (5-10 μm) films, whereas these phenomena do not take place for the thin spin-coated films. The rate of the crater formation, their depth and diameter are the same, i.e. the chirality has no influence on kinetics and the depth of photoinduced craters. It is shown, that for the nonaligned LC-films no preferable directed mass transport nearby photoinduced holes was found, but in the case of the uniaxially aligned nematic polymer the mass-transport occurs only in direction along LC-director and does not depend on the laser polarization direction.

The second part of the work deals with the optical and structural studies of chiral-photochromic LC systems (cholesteric oligomer cyclosiloxanes doped by azobenzene compound (Chol)) using the above-mentioned technique. It was found the considerable difference in surface topology of the slowly-cooled and quenched oligomer films. The former samples are characterized by a large number of “valleys” with spiral structure; the latter ones form the spiral superstructured “hills”. The unusual photoinduced processes caused by polarized light irradiation (532 nm) are accompanied by the structural transformations and directional mass-transport of chromophores and mesogens (Fig. 2). The model describing the photoinduced topography changes is suggested.

This research was supported by the Russian Foundation of Fundamental Research (13-03-00648, 13-03-12071 and 13-03-12456).

Fig. 1. AFM scans of the mixture PA+Sorb film before and after 2 min of irradiation by focused laser beam.

Fig. 2. AFM images of the Chol surface before and after irradiation.