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Dependence of spontaneous surface relief gratings formation on the incidence angle and the polarization of the pump beam

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Materials containing azobenzene chromophores have been utilised for all-optical surface patterning because of their photoresponsive properties. When azobenzene derivatives are irradiated with a polarized light beam with wavelengths within their absorption band, they undergo a reversible cis-trans isomerization process leading to a molecular reorientation, and further illumination results in mass movement. Irradiation of thin films of azobenzene moieties with a light interference pattern leads to the formation of surface relief gratings (SRG). Surface relief structures can also be formed under single-beam exposure, where no external interference pattern is applied, and thus the structures form spontaneously. The profile of these spontaneous surface relief gratings (SSRG) depends enormously on the polarization and the incidence angle of the pump beam. In this work, dependence of SSRGs on the polarization and the incident angle of the pump beam has been studied on thin films of a Disperse Red 1- functionalized glass-forming compound. Under normal irradiation of linearly polarized beam, the SSRG consists of a patchwork of domains with gratings along two different directions with a grating vector of 40 degrees relative to the pump beam polarization direction. However, for oblique irradiation, SSRGs with distinct pitches and directions form. Samples were rotated about y axis (vertical axis) to obtain different incident angles. Polarisation on the surface of the sample remain unchanged for s (vertical) polarization regardless of incidence angle. In this case, rotating of the sample only modifies the k-vector of the pump beam on the surface of the sample. As the angle of incidence increases the pitch of the SSRG also increase. However, for other polarization states, changing incidence angle also affects the polarisation state on the surface of the samples. As polarization component in z direction (in direction of the sample thickness) increases, the amplitude of the SSRGs increases.

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