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Small-angle scattering due to formation of periodic structures in light-sensitive films

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The small-angle scattering patterns are studied arising in thin AgCl films containing granular silver due to formation of spontaneous periodic structures under irradiation by a P-polarized and circularly polarized laser beam (He–Ne laser, $P = 8$ mW, $\lambda = 632.8$ nm). Irrespective of the polarization character, the main contribution to the small-angle scattering at incident angles exceeding 4° has been found to be due to diffraction of waveguide modes excited by dominant C-gratings in neighboring micrograting with vectors $\mathbf{K} \neq \mathbf{K}_c$. Under circularly polarized light, the small-angle scattering patterns are found to become complicated due to formation of S-gratings and secondary regular gratings associated therewith.

В тонких пленках AgCl, содержащих гранулярное серебро, исследованы картины малоуглового рассеяния, возникающие при формировании спонтанных периодических структур P- и циркулярно поляризованным лазерным пучком (He–Ne лазер, $P = 8$ мВт, $\lambda = 632.8$ нм). Обнаружено, что независимо от характера поляризации основной вклад в малоугловое рассеяние, при углах падения больших 4°, дает дифракция волноводных мод, возбужденных доминантными С-решетками на соседних микрорешетках с векторами $\mathbf{K} \neq \mathbf{K}_c$. При действии циркулярно поляризованного света обнаружено усложнение картины малоуглового рассеяния, вызванное формированием S-решеток и связанных с ними вторичных регулярных решеток.

Periodic structures (PS) are known [1] to be formed in light-sensitive films under irradiation by one laser beam. The PS formation is associated with excitation of TE and TM waveguide modes due to the light scattering in the films and their interference with the incident beam. The induced grating period depends on the effective refraction index of the waveguide mode, the laser beam angle of incidence and its polarization, and the scattered mode azimuth. Since the scattering centers in the films are disordered, the resulting PS is a set of diffraction micrograting (McG) of several micrometer size mismatched in the initial interference pattern phase, the wave vector **K** value and direction. The McG period is as a rule smaller than the inducing beam wavelength λ, therefore, it is somewhat difficult to observe the diffraction patterns *in situ* and to study the PS evolution during its development. When a PS arises, however, a characteristic small-angle scattering (SAS) appears that can be observed using screens positioned either behind the sample being irradiated or between the sample and the laser. Unlike the usual diffraction, the SAS is due to the mode re-emission by the micrograting having different **K** vectors [1–3]. The SAS pattern bears information on the type of McG being formed, the azimuth scatter of their vectors **K**, allows to trace their time evolution [3, 4] and competition. Another type SAS associated with volume noise gratings in photoreactive crystals was observed in [5, 6]. In this work, presented are the study results of SAS arising under AgCl–Ag light-sensitive films at inclined incidence of circularly polarized and P-polarized laser beam. The SAS patterns have been considered at different angles of incidence and their distinctions under linearly and circularly polarized beams have been