

Methods for creating submicron structures by direct laser writing

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Abstract: Today, direct laser recording technology is gaining significant popularity in the field of optoelectronics for creating high-quality diffractive optical elements on substrates of arbitrary sizes. It allows one to quickly form optical elements for various purposes, namely angular scales, limbs and diffractive elements without the use of phototemplates, which allows you to speed up the manufacturing process and improve the quality of the structures. Direct laser recording technology is based on scanning and exposing the surface of the substrate covered with a photoresist layer to a focused amplitude-modulated laser beam. Technological equipment for direct laser recording can be created using laser recording stations, which were used in the technological process of manufacturing compact discs. The optical system of the laser recording station uses a focusing lens with a numerical aperture of 0.70-0.95, located on piezoactuator of the laser beam automatic focusing system. The use of a high-aperture lens will allow focusing of the laser beam to submicron sizes. To record two-dimensional images at the laser recording station, an angular reference encoder is used to form sector marks with a resolution P , which is selected according to the substrate diameter D so that the D/P ratio is 0.7–1.2 μm . The size of the elements formed in the process of direct laser recording is significantly influenced by the characteristics of laser radiation, such as the intensity distribution of the focused laser beam, scanning speed and focusing accuracy. Of fundamental importance for the formation of submicron structures is the use of nonlinear interaction of the laser with a photosensitive material, which allows one to bypass the limitations in resolution, which are determined by the Rayleigh criterion. Experimental studies of direct laser recording have shown the possibility of creating images with high resolution (Fig. 1).

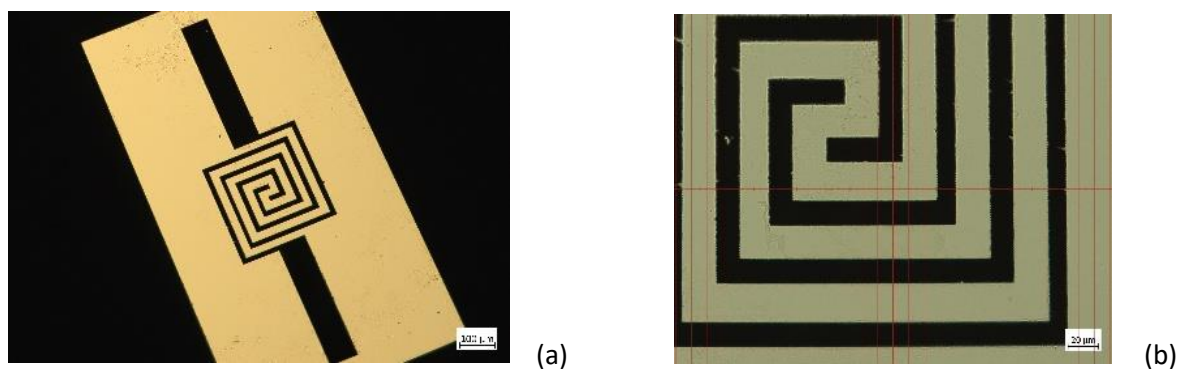


Figure 1. An optical image of representative metal structures fabricated by direct laser recording. The length of the scale bar is 100 μm in (a) and 20 μm in (b).

Keywords: direct laser recording, diffractive optical elements, laser recording station, photosensitive material