V. I. Sukhanov. *Phase holograms in recording media with dispersive refraction.* Progress in research on three-dimensional holography requires the development of new three-dimensional recording media for producing highly efficient phase holograms for long-term use. Definite progress has been made in this direction by a new approach to the development of recording media, which is based on the "principle of sensitized dispersive refraction." [1] According to this approach, phase holograms can be produced by simply arranging processes which would result, after a development process, in sharp spectral differences between exposed and unexposed parts of the material, thereby minimizing the absorption of the light used to reconstruct the hologram.

The principle underlies the development of a new polymer recording material, reoxan.[1] In reoxan, sharp changes in the absorption spectra and accompanying changes in the

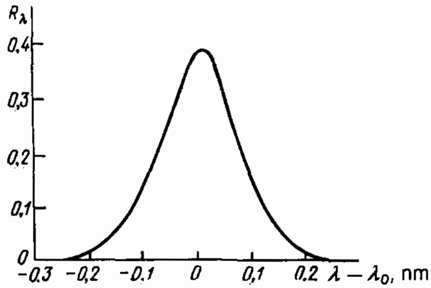

FIG. 1. Spectral reflection coefficient of a narrow-band holographic selector using reoxan ($\lambda_0 = 530$ nm).

refractive index of a medium are caused by a sensitized photooxidation of anthracene compounds. Studies have shown that this material is suitable for recording holograms in both copropagating and counter propagating beams.[2,3] Since the photoinduced change in the refractive index of reoxan which is attainable is proportional to the oxygen concentration in the polymer matrix, it is possible to record holograms and to read them out nondestructively. It is also possible to produce holograms with an apodizing angular (or spectral) selectivity lineshape.

The useful new properties of reoxan have been used in the development of narrow-band holographic spectral selectors[4] with a band half-width ~0.1 nm, a high reflection coefficient at the band peak, and a low spectral background (Fig. 1).

The development of reoxan has finally made it possible to take up experiments on the formation of deep three-dimensional holograms of complex wavefronts. This research has revealed a unidirectional exchange of energy during the recording of holograms of a diffuse object in a photorefractive medium with a local response. This energy exchange is a consequence of an intermodulation structure of the hologram[6] and leads to an intensification of the diffuse wave.[5] This effect may be exploited to intensity images in coherent image-processing systems. Furthermore, experiments on multiply exposed holograms and on holograms with a coded reference beam have shown that reoxan can be used to develop devices for storing information and holographic memories with a recording density one or two orders of magnitude higher than that in similar devices with a two-dimensional information carrier.[7]

The advantages of the principle of dispersive refraction have been demonstrated not only in the example of reoxan but also in experiments on the development of phase holograms using silver halide film by the method of the replacement of silver by a dye[8] and also in the results of studies carried out to develop new diazopolymers for holography.[9] In both photographic film and diazopolymers the spatial distribution of the light intensity in the interference pattern is recorded in the volume of the medium in the form of a corresponding spatial distribution of the azo dye, whose absorption spectrum lies outside the hologram reconstruction region. By virtue of the dispersion relations, gradients in the dye concentration give rise to a phase modulation in the working spectral region, i.e., to the recording of a purely phase hologram. It has been shown experimentally that diazopolymers can be developed into volume phase holograms with a physical thickness (~20 mm) essentially unattainable with polymer media of other types.

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