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"Volume Shrinkage in Slant Fringe Gratings of a Cationic Ring-Opening Volume Hologram Recording Material", D.A. Waldman, H.-Y.S. Li, and M.G. Horner, Polaroid Corporation, 750M-5C, Cambridge, MA 02139

Abstract

A new photopolymer holographic recording material, ULSH-500, based on cationic ring-opening polymerization, has been further optimized to achieve low transverse shrinkage without sacrificing sensitivity. The extent of transverse (z) and lateral (x) shrinkage was determined explicitly in this study for a range of slant angles in volume recorded to near saturation and in holograms of low diffraction efficiency. The values of $\Delta K_x/K_x$ and $\Delta K_z/K_z$, which represent the physical material shrinkage in the grating vector plane, were ascertained by (1) direct measurement of the differential angle changes in the reference and signal beam angles necessary to achieve Bragg matching and (2) measurement of the average refractive index. The accuracy of this method was primarily limited by the exactness in determining the angle of peak efficiency in the Bragg selectivity curve. It is demonstrated that the peak angle can be established to within a small fraction of a degree. It is shown that the assumption of anchoring and, thus, uniaxial shrinkage as embodied in the conventional fringe rotation model cannot be applied for the photopolymer ULSH-500 under the recording conditions used herein. It is demonstrated that background uplift in angular selectivity profiles can be attributed to nonuniformity in the grating strength throughout the transverse direction of the recording media, and that the uplift can be reduced to negligible levels by using a low fluence pre-imaging exposure. Calorimetric analysis of reaction kinetics was performed using direct laser irradiation delivered by optical fiber to a differential scanning calorimeter.