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ABSTRACTS

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Coherent Self-Enhancement of Dynamic Gratings in W-75 Molecular Glassy Films

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I. Introduction

Self-enhancement (SE) of a dynamic hologram is the increase in its diffraction efficiency (DE) over time under the stimulus of a single beam light irradiation or simply in the dark [1]. Three types of SE can be distinguished: (i) coherent SE (CSE) due to the holographic recording by diffracted waves; (ii) incoherent SE due to the contrast and/or transmission increase of a hologram by incoherent light; (iii) relaxational (or dark) SE due to the contrast and/or transmission increase of a hologram by thermostimulated relaxation processes. All three SE types can take place simultaneously [1].

In this paper we have experimentally studied the CSE polarization dependence of dynamic transmission holographic gratings (HG) recorded in molecular glassy films **W-75.** A strong effect of recording and enhancing light polarizations on CSE is found. The highest CSE factor (showing the DE increase with respect to the initial DE) of 14.5 was achieved in the case or recording and enhancing the grating by circular *L*-polarizations.

II. Experiments and Results

W-75 (also **IWK-2D**) azobenzene glassy 3μm thick films synthesized in our Faculty in the group of *prof.* V. Kokars were used in experiments. Their precise chemical notation is 2-(3-(4-((4-(bis(2-(trityloxy)ethyl) amino) phenyl)diazenyl)styryl)-5,5-dimethylcyclohex-2-enylidene) [2]. Films were spin-coated onto the glass substrates.

Two symmetrically incident laser beams with the total light intensity of 1.18 W/cm^2 were used for the transmission HG recording at 632.8 nm. Recording intensity was 0.87 W/cm^2 at 532 nm. HG period was 2 μm. Three pairs of linear recording beam polarizations (*p-p, s-s, s-p*) and two pairs of circular recording beam polarizations (*L-L* and *L-R*) were applied (*L*-left rotation, *R*-right rotation). After the HG recording with two beams up to about DE = 0.1 % the recording was continued by one of the recording beams. This was the CSE process.

No CSE was found at 632.8 nm regardless of polarization. Instead, a fast erasure (except *L*-readout of *L-L* and *L-R* HG) took place. It is surprising because our previous results [2] have shown more efficient recording at 632.8 nm compared to 532 nm. Besides, we have previously observed CSE in **W-75** films at 632.8 nm with orthogonal *s-p* polarizations [1]. On the contrary, CSE took place in almost all cases (except *s-p* polarizations) at 532 nm including orthogonal circular recording polarizations (Fig. 1, Table 1). Thus one can suggest that recording mechanisms are different at 532 and 632.8 nm. These results also show that even slight film structure changes can influence the CSE effect.

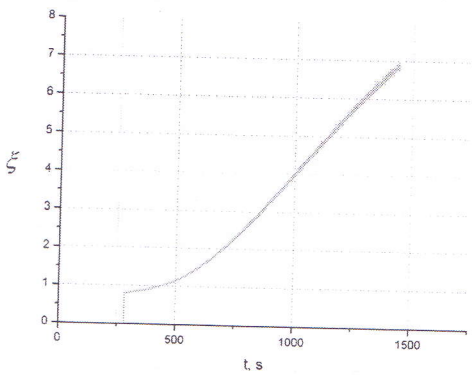

Figure 1. CSE factor versus exposure time in the case of *L-R* vector grating enhanced by *R*-beam. Recording and CSE wavelengths were equal to 532 nm.

TABLE I
Polarization dependence of maximal CSE factor at 532 nm

Recording beam polarizations	Enhancing beam polarization	Maximal CSE factor, ξ_{max}
s-s	*s*	1.75
p-p	*p*	3.6
s-p	*s*	<1
s-p	*p*	<1
L-L	*L*	14.5
L-R	*L*	1.9
L-R	*R*	7.0

References

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