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Thermal effects during the recording of holographic diffraction gratings in HPDLC

Wafaa MILOUA[1]*, Marta MORALES[1], Manuel GUTIERREZ[2], Manuel ORTUÑO[1, 2], Inmaculada PASCUAL[1,3]

1Instituto Universitario de Física Aplicada a las Ciencias y las Tecnologías, Universidad de Alicante, P.O. Box 99, E-03080, Alicante, Spain
2Departamento de Física, Ingeniería de Sistemas y Teoría de la Señal, Universidad de Alicante, P.O. Box 99, E-03080, Alicante, Spain
3Departamento de Óptica, Farmacología y Anatomía, Universidad de Alicante, P.O. Box 99, E-03080, Alicante, Spain

Contact: wafaamiloua42@gmail.com

Abstract:

Optical holography is a method that can record the complete characteristics of a light wave. Therefore, it is possible to record three-dimensional images of an object. Holographic image differs from photographic image as it has perspective and depth and can be viewed from various angles[1]Photopolymers have been far studied as holographic recording media yielding excellent results. Particularly, holographic polymer dispersed liquid crystals (HPDLCs) are expected to be the most promising materials in tunable holographic devices. HPDLC's has unique properties due to the incorporation of liquid crystals as materials susceptible to change their refractive index.

They are made by holographic recording in a photopolymerization induced phase separation process (PIPS) in which the liquid crystal molecules diffuse to dark zones in the diffraction grating where they can be oriented by means of an electric field[2]. The orientation of the liquid crystal produces a refractive index variation, which changes the diffraction efficiency.

Therefore, the grating develops a dynamic behaviour that may be modified by means of an electronic device. In this manner, it is possible to make dynamic devices such as tunable-focus lenses, sensors, phase modulators, or prism gratings[3]

In this work, we discuss the influence of the temperature on the recording of a hologram in HPDLC samples. We use a standard holographic setup with two symmetric beams from 532 nm solid-state laser, and one beam for the reconstruction of the hologram from a He-Ne laser.

During the experimental work, we noticed that some samples still colorless to the naked eye before and after laser exposure (sample 1).whereas other samples become opaque (white color) during laser exposure (sample 2). Figures 1 and 2 show the samples. The white color in sample 2 is due to the rearrangement of liquid crystal molecules during the recording process.

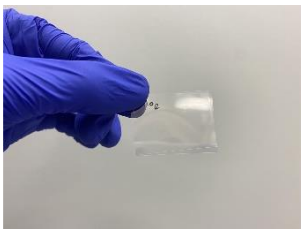

Figure1: sample 1 (513-17 AB)

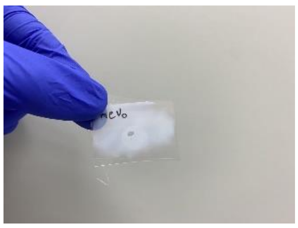

Figure2: sample2 (mev0)

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Figure 3 shows the transmission efficiency (TE) versus energy exposure (E) for two samples of HPDLC. Sample 2 was obtained while a decrease in ambient temperature was taking place.

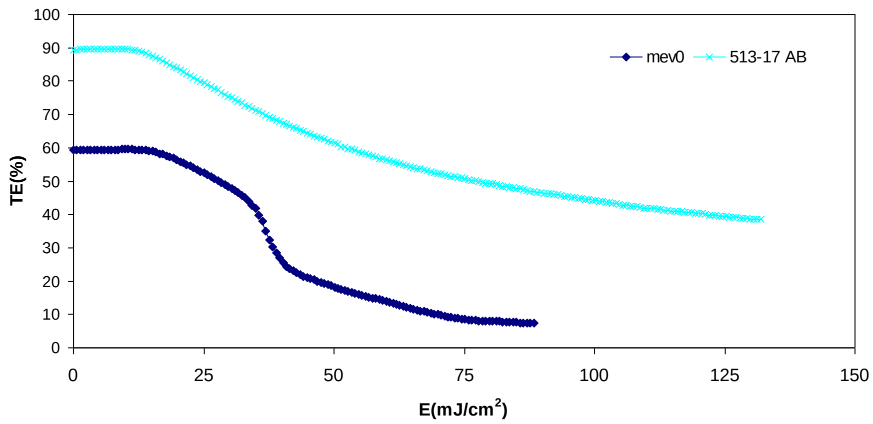

Figure3 :Transmission efficiency versus energy during the recording of the diffraction grating

Results: Sample 1 is colorless to the naked eye before and after laser exposure whereas sample 2 becomes opaque (white color) during laser exposure. At the start of recording the sample 1 (513-17 AB) has a high transmission efficiency TE= 90% and the sample 2 (mev0) has a relative low value (60%). This is related to the high light diffusion of sample 2 (energy losses). During the recording, TE= [39-90]% for sample 1 and TE=[7-60]% for sample 2. The last one needs less energy (88 vs 132 mJ/cm^2) to obtain a similar decrease of the TE. These results are related to the rearrangement of liquid crystal molecules during the recording process. For sample 2, a localized decrease in ambient temperature below 23 ºC induces the formation of ordered structures within the material due to the association of liquid crystal molecules. Therefore, the energy losses due to light diffusion are very high for sample 2.

Conclusion: An adequate ambient temperature is one of the most important factors that affects the holographic recording in a hologram. In our study, the low temperature a visible ordered structures within the material (white color), due to the rearrangement of liquid crystal molecules during the recording process.

References:

1. Samui AB;Holographic Recording Medium, 74-94,(2008).
2. Riquelme M, Ortuñoa M,Márqueza A, Gallegoa S, Pascuala I, c, Augusto Beléndeza B; A dynamic beam splitter using polymer dispersed liquid crystals materials. 8498:1-11, (2012)
3. Ortuño M, Riquelme M, Gallego S, Márquez A, Pascual I, Beléndez A;Overmodulation Control in the Optimization of a H-PDLC Device with Ethyl Eosin as Dye,(2013)

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