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HOLOGRAPHIC PHOTOPOLYMER WITH PENTAERYTHRITOL TRIACRYLATE

A. Fimia, F. Mateos and A. Beléndez

Laboratorio de Optica, Departamento Interuniversitario de Optica
Universidad de Alicante, Apdo. 99, Alicante 03080, SPAIN.

R. Mallavia, F. Amat-Guerri and R. Sastre

Instituto de Polímeros, and Instituto de Química Orgánica,CSIC
Juan de la Cierva 3, 28006 Madrid, SPAIN.

ABSTRACT

New holographic recording material based on photopolymerizable systems have contributed significantly to recent growth of holographic applications. Previously, we report that on photopolymerizable system with the presence of the difunctional monomer, ethylene glycol dimethacrylate (EGDMA) improves the behaviour of the system and particulary to elucidate the role played by eosin ester with oxooxime group in the production of amine initiator radicals. This comparative study has been carried out in our laboratory using differential scanning photocalorimetry and holography.

The results of the new photosensitive recording material for holography indicate that this system can be used for the formulation of very promising photopolymer with better performance. The aim of this work has been changed the corsslinking monomer to decrease the energetin sensitivity and knowed the rest of the behavior. The new photopolymerizable mixture containing pentaethritol triacrylate (PETA) in the same relation with the ethylene glycol dimethacrylate mixture. A diffraction efficiency of 80 % is achieved with a energetic sensitivity of 3 J/cm^2 at 514 nm., and the spatial resolution is up to 2000 l/mm.

Key Words: Holographic Recording Materials, Photopolymers, Photochemestry.

I. INTRODUCTION

One of the most important aspect of holographic material is its energetic sensitivity in the area of the spectrum in which the sensitizer used in its composition acts. Previous studies have produced a new sensitizer that permits a forty-fold increase in energetic sensitivity (1). However, the system of monomers used continues to have a low degree of sensitivity and requiere energies around 1 J/cm2.In this study we incorporate a new composition into the system of monomers in order to increase photopolymerization speed by increasing energetic sensitivity while at the same time maintaining other important properties of the holographic recording material such as its response to changes in spatial frecuency and its diffraction efficiency.

II. EXPERIMENTAL RESULTS

The experiments were carried out using a holographic set-up in which two collimated beams were made to incide on the sample which was placed between two 10x10 cm, sheets of glass with spacers that guaranteed a thickness of 45 µm. The waveleght used was 514 nm., from an Ar laser. In Table I we present tha base composition of the system to which we have added a PETA component in different concentrations.

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TABLE I

N-methyldiethanolamine (MDEA) 3.9 10^{-2} M
Photoinitiator 1.9 10^{-3} M
Ethylene glycol dimethacrylate (EGDMA) 3.9 10^{-2} M

Figure 1 shows the response of the diffraction efficiency as a function of the recording energy for compositions including EGDMA and PETA for different spatial frecuencies.

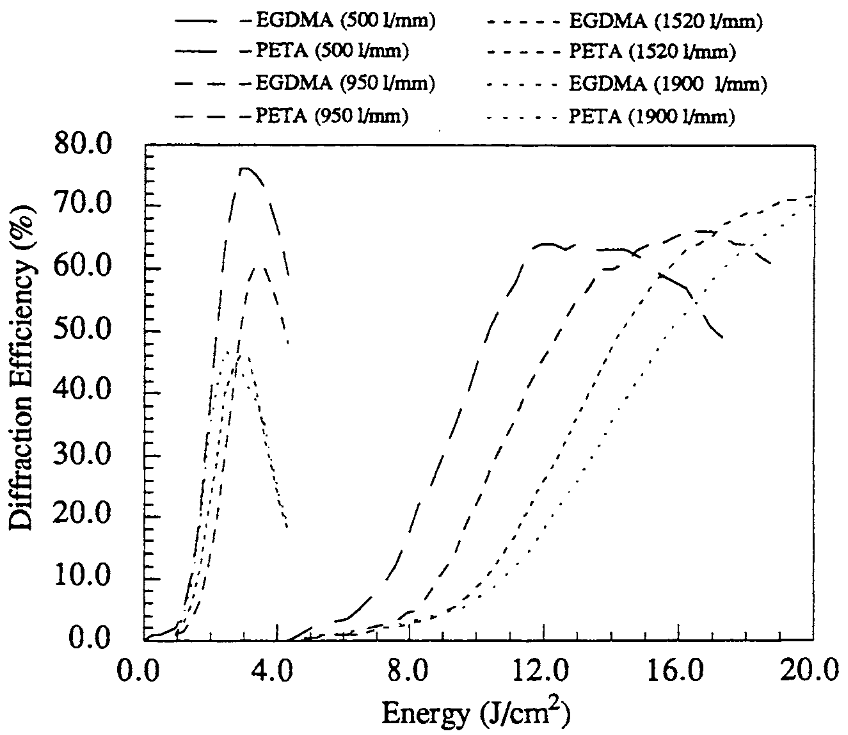

Figure 1

A summary of these results is presented in figure 2, which shows a bit of a decrease in the diffraction efficiency when the spatial frecuency is increased for compositions with PETA.

However, as figure 3 shows, the energy needed to reach maximun diffraction efficiency is the same for different spatial frequencies for PETA but not for EGDMA, as the latter requires four times more energy at low spatial frequencies and seven times more at high spatial frecquencies.

One important aspect is the linearity of the response of the PETA when analyzing the energy needed to reach maximum diffraction efficiency as a function of the intensity required to store the holographic grating.

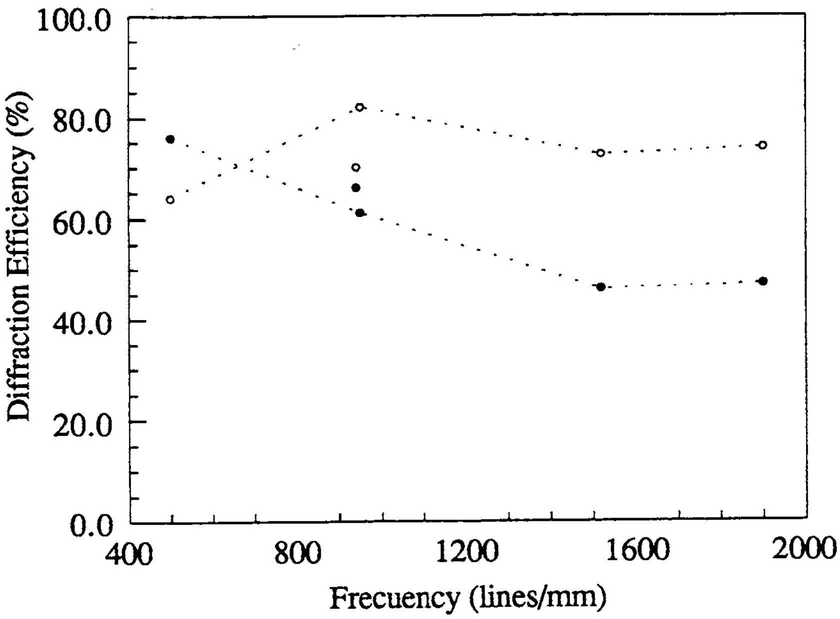

Figure 2

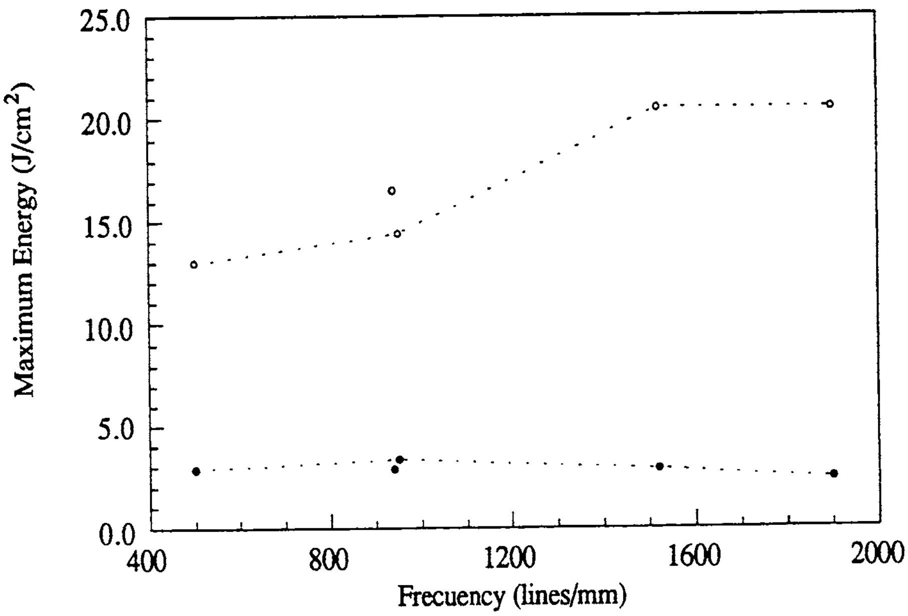

Figure 3

However, as figure 4 shows the response of the EGDMA is non-linear. If we do a study of the diffraction efficiency as a function of storage intensity, we find that the behavior of both systems is similar even though the PETA system reminds us a great deal of the conversion curves of a typical polymerization reaction.

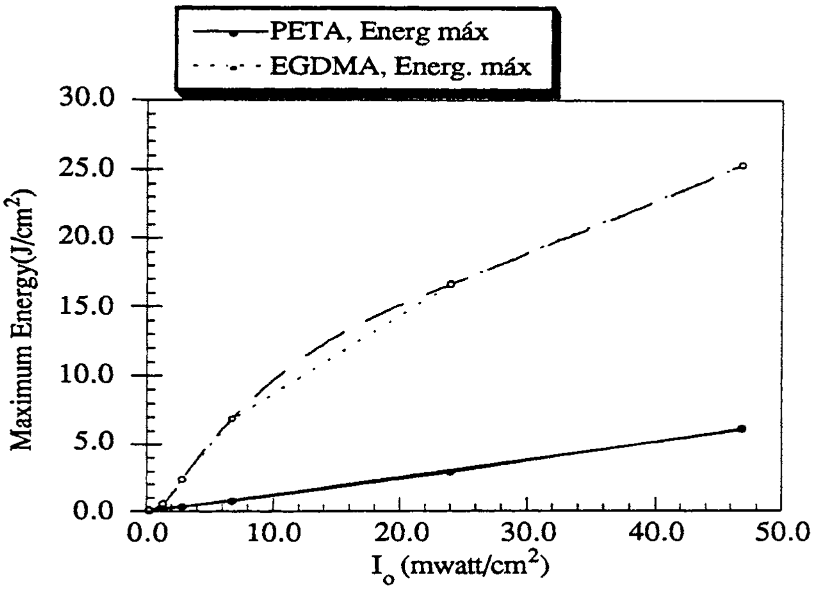

Figure 4

The influence of PETA concentration can be analyzed very well as can be seen in figure 5 in wich we have studied both systems with different concentrations of PETA.

We can see that there is a quantity in both cases that optimizes the diffraction efficiency of the composition and that a 70% diffraction efficiency is reached in both cases.

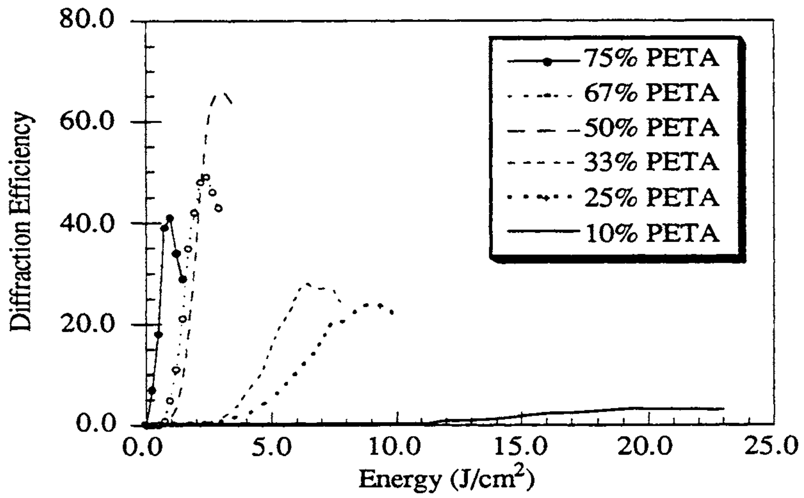

Figure 5

III. CONCLUSIONS

The correct selection of the composition and utilization of PETA type components make it possible to increase the sensitivity of photochemical systems that work through photopolymerization. Once again it has been shown that these systems are non-linear behavior in relation to storage intensity. By using these systems, diffraction efficiencies of almost 80% can be achieved when energy is 3 J/cm^2.

IV. ACKNOWLEDGMENT

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V. BIBLIOGRAPHY

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