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Photorefractivity of the Blend Based on Poly(N-Vinylcarbazole) and Azo Dye-Functionalized Polymer

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Photorefractive polymers based on the blend of poly(N-vinylcarbazole) and azo dye-functionalized nonlinear optical polymer were prepared for the enhancement of phase stability in a photorefractive system. Polymer blends with homogeneous phase showed increased gain coefficient with increase in the content of azo dye groups, charge generator and plasticizer in the blend.

Keywords: photorefractive polymer blend; photoconducting polymer; nonlinear optical polymer

INTRODUCTION

A polymeric material can potentially be made photorefractive either by doping guest molecules into the polymer(composite polymer system)[1,2] or by incorporating several functional groups directly into the polymer(fully functionalized polymer system)[1,3]. It is generally understood that composite polymer systems have the problems associated with the inherent metastability of doped small molecules, and the photorefractivity of fully functionalized polymer systems cannot be easily optimized.

In this study, we investigated the photorefractive performance of new photorefractive polymer systems based on the blend of poly(*N*-vinyl carbazole)(PVK) and azo dye-functionalized nonlinear optical polymer(NLOP) which was expected to enhance the phase stability and performance reproducibility with time.

EXPERIMENTAL

NLOP was synthesized by copolymerization of methylmethacrylate and the nodified methylmethacrylate monomer with a substituent of containing Disperse Red 1 (DR1) according to published methods[4] with modifications. Several concentrations of NLOP, Buckminsterfullerene(C_{60}) and *N*-ethylcarbazole(ECZ) were added to PVK and the mixture was dissolved in chlorobenzene. The material was sandwiched between two indium tin oxide (ITO) coated glasses and hot pressed. Samples with thickness between 50 and 60μm could be produced by polyimide spacer layer. The photorefractive properties of these systems were determined by two beam coupling experiment.[5] A diode laser with λ=670nm was used as the light source which was split into two beams with equal intensity.

RESULTS AND DISCUSSION

The structural evaluation of NLOP was made by ^{1}H NMR spectra given in Figure 1. The peak for the methylene proton (d') of -CH_2CH_2OCO- appeared at δ= 4.23ppm, which indicates the substitution of DR1. The peak for the solvent ($CDCl_3$✓) appeared at δ= 7.26ppm.

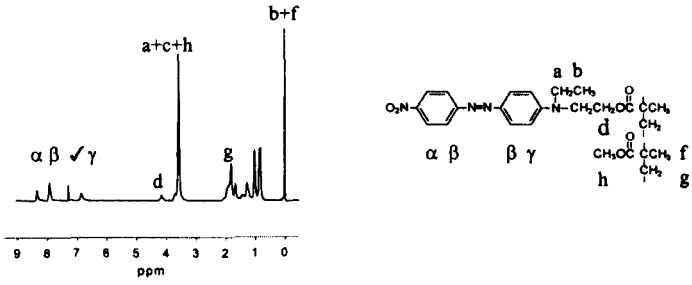

FIGURE 1 ^{1}H NMR spectrum of NLOP

In order to compare the phase stability of photorefractive polymer blend and composite system, the optical microscopic images of photorefractive polymers based on the blend containing PVK, NLOP, C_{60} and ECZ and photorefractive polymer composites containing PVK, DR1, C_{60} and ECZ were investigated.

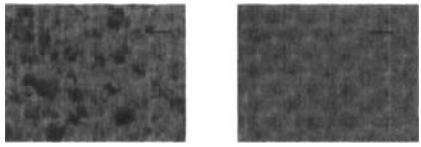

FIGURE 2 Optical microscopic image of (a) composite and (b) blend
(___ : 100μm)

As shown in Figure 2, the phase separation of DR1 molecules in the photorefractive polymer composite was observed while the homogeneous optical microscopic image was obtained for the photorefractive polymer

blend. This may be attributed to the crystalline-free structure of the nonlinear optical polymer.

Figure 3 shows the gain coefficient of photorefractive polymer blend as a function of NLOP, C_{60} and ECZ content. External electric filed strength was around 10V/μm. Optical gain of photorefractive polymer blend was found to increase with increasing the NLOP, C_{60} and ECZ content in the blend. This seems to be closely related to the enhancement of the electro-optic effect, space charge field, and poling efficiency.

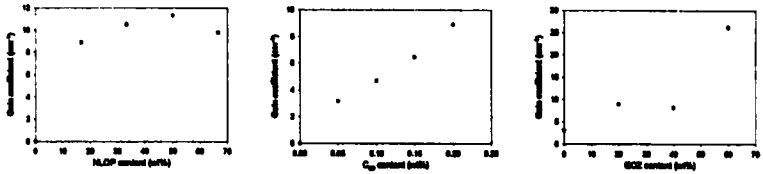

FIGURE 3 Optical gain of photorefractive blend with (a)NLOP (b)C_{60} (c)ECZ

Acknowledgment

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