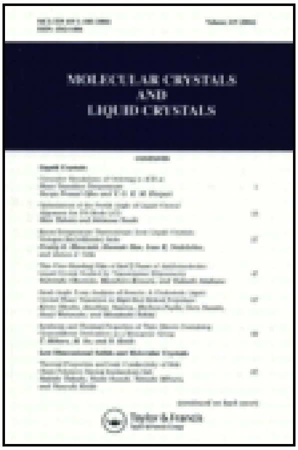

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The Highly Efficient Polymeric Photorefractive Materials: Influence of Alkyl End Group of Chromophore on Photorefractive Properties

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The Highly Efficient Polymeric Photorefractive Materials: Influence of Alkyl End Group of Chromophore on Photorefractive Properties

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ABSTRACT Photorefractive composites based on carbazole-substituted polysiloxane, doped with a series of NLO chromophores and photo-sensitizer were presented. The alkyl end group of chromophore was observed to influence electro-optic and photoconductivity of composite, in addition to device stability. And the gain coefficient of composite containing 4-diethylaminobenzylidene malonitrile as a chromophore was over 100 cm^{-1} at 60 V/μm. And gain of composite was *ca.*2.0 at 90 V/μm, which indicates that the pump beam was almost transferred to the signal beam.

KEYWORDS photorefractive; chromophore; electro-optic; photoconductivity; alkyl end group.

INTRODUCTION

Photorefractive (PR) effect is a spatial modulation of refractive index of material under the nonuniform illumination of light.[1] Of the many organic materials designed for photorefractive applications, the low glass transition (Tg) composites based on photoconducting polymer doped with nonlinear optical chromophore and charge generator have exhibited the most promising results.[2] For the preparation of the highly efficient photorefractive composite, the design of chromophore with the high optical property is of critical importance. And the solubility of chromophore in polymer matrix is the prerequisite for the sample stability. Frequently the molecular structure of chromophore has been modified by attaching the alkyl group onto chromophore to enhance the solubility. However, even the minor modification of chromophore was observed to affect photorefractive property.[2, 3]

Hence in this work, a series of NLO chromophores have been prepared by varying the alkyl end group and the photorefractive behaviors of polymeric composites were discussed.

EXPERIMENTAL

Carbazole-substituted polysiloxane (PSX) and NLO chromophores with dicyanostilbene moiety were synthesized, as given in Figure 1. PR composites, which consist of PSX (69 *wt* %), chromophore (30 *wt* %), and TNF (1 *wt* %), were prepared. The electro-optic property of composite was determined by transmission ellipsometric method. Photoconductivity was measured at the wavelength of 632.8 *nm* (I = 1.18 *mW*) using a simple *DC* photocurrent technique. The photorefractive property was characterized at the wavelength of 632.8 *nm* by the two-beam coupling (2*BC*) method.[2]

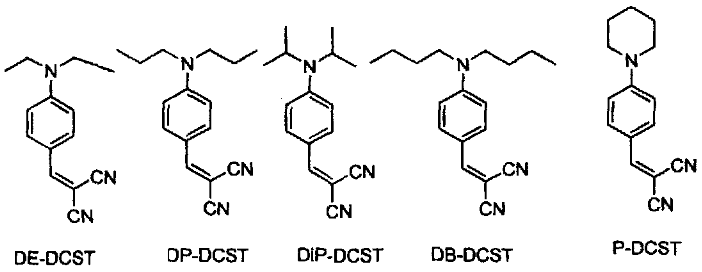

FIGURE 1 Chemical structures for NLO chromophores

RESULTS AND DISCUSSION

Alkyl end group is generally incorporated onto chromophore in order to modify its solubility and rotational mobility in matrix. However, the attaching of alkyl substituents is observed to accompany the variation of the optical properties of composite, as shown in Figure 2 and

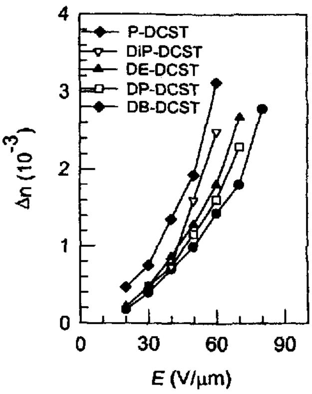

FIGURE 2 EO properties of various composites

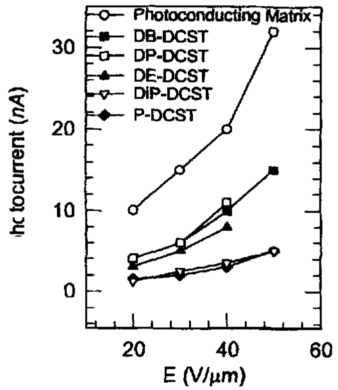

FIGURE 3 Photoconductivity of various composites

Figure 3. For example, EO properties of PDCST composites is ca. 2 times better than that of DBDCST composite. In contrast, the photoconductivity of the former composite is worse than the latter composite. The values of gain coefficient for P-DCST, D*i*P-DCST, DE-DCST, DBDCST composites are 150, 145, 140, 100cm^{-1} at 70 V/μm, respectively, reflecting the order of EO properties. Figure 4 exhibits the photorefractive properties of DE-DCST composite at various electric fields. The gain coefficient of DE-DCST composite is over 100cm^{-1} at 60 V/μm and the pump beam is almost transfer to signal beam at 90 V/μm.

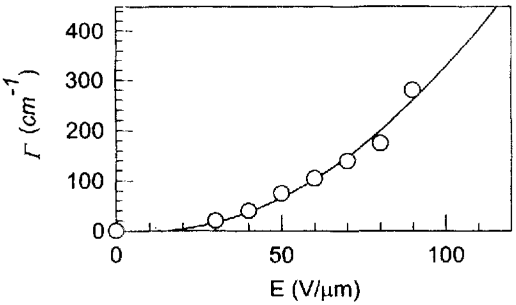

FIGURE 4 *Γ* vs. *E* for DE-DCST composite.

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