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Novel Chromophores for Highly Efficient Photorefractive Materials

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Barbituric acid derivatives are synthesized as the electro-optic chromophores for photorefractive application. When doped with new chromophores the photorefractive composites which consist of polysiloxane with pendant carbazole as photoconducting host show very large gain coefficient ($\Gamma = 219\text{cm}^{-1}$ at $100\text{V}/\mu\text{m}$).

Keywords: photorefractive; electro-optic; barbituric acid derivatives

INTRODUCTION

Since the first discovery in 1991 the research on organic photorefractive materials has attracted great attention because of the potential applications in optical image processing, dynamic holography, high-density optical data storage, optical computing, and pattern recognition¹.

Most of the studies have been focused on the development of photorefractive chromophores, which possess high gain, good processability, and stability. In this work, barbituric acid derivatives were designed for NLO chromophores to obtain the highly efficient photorefractive materials.

EXPERIMENTAL

A carbazole-substituted poly(siloxane) was synthesized by the procedure described in the previous paper as shown Figure1.² All chromophores were prepared by condensation of aldehydes with barbituric acid derivatives. The high yield (~95%) was obtained by simply refluxing the stoichiometric amount of both reagents in ethanol.³

The polymer composites consisted of carbazole-substituted poly(siloxane) (PSX-Cz, 69wt%) doped with chromophore (30wt%) and of 1,4,7-trinitro-9-fluorenylidene (TNF, 1%). The composites were sandwiched between two indium-tin-oxide (ITO) coated glass plates at 80 °C to yield samples with thickness of 100 μm .

The photorefractive properties were investigated by two beam coupling (TBC) experiment using He-Ne laser.⁴ Transmission ellipsometric measurement was carried out to study the poling process.⁵

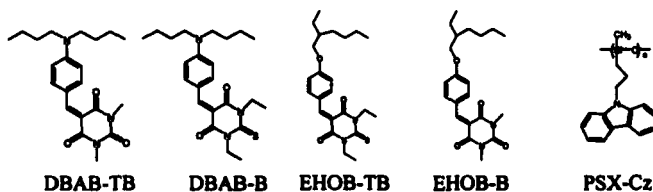


FIGURE 1 Chemical structures of materials used in this work

RESULTS AND DISCUSSION

The properties of NLO chromophores were observed to be strongly influenced by the strength of the donor and the acceptor as shown in TABLE 1. Photorefractive materials should have the electro-optic property, which modulate the refractive index under space-charge field. The electro-optic effect originates from the alignment of chromophores in noncentrosymmetric structures under the poling field. According to the calculation of MOPAC6, DBAB-TB and DBAB-B have higher values of $\Delta\alpha$ and β than those of EHOB-TB and EHOB-B, probably due to the stronger electron donor. The difference in refractive index, Δn , was measured by transmission ellipsometric technique. As shown in Figure 2 (a) Δn is increased quadratically with the applied electric field due to induce the alignment of chromophores along field direction. The experimental results for electro-optic coefficient are in good agreement with those of MOPAC.

TABLE 1 The properties of NLO active chromophores

	DBAB-TB	DBAB-B	EHOB-TB	EHOB-B
λ_{\max} (nm) ^a	492	464	424	394
μ (D) ^b	6.27	3.90	5.87	3.11
$\Delta\alpha(\alpha_{\parallel} - \alpha_{\perp})$ (10 ⁻²³ esu) ^b	5.98	5.91	3.79	3.70
β ^b (10 ⁻³⁰ esu)	21.5	20.0	8.50	8.76

^a Measured by UV-Vis spectrum, ^b Calculated from MOPAC6

The two beam coupling results of composites are given in Figure 2 (b). As the applied electric field increases, DBAB-B with the high EO coefficient shows high photorefractivity. The gain coefficient of EHOB-TB is relatively low, reflecting that gain is proportional to electro-optic property. In the case of DBAB-TB no net gain was expected due to the high absorption ($\alpha = 120 \text{ cm}^{-1}$).

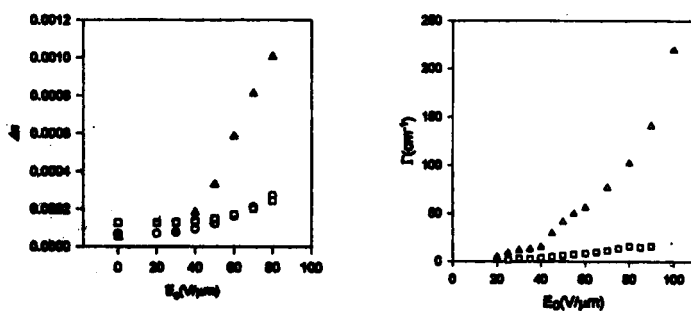


FIGURE 2 (a) Δn vs E for composites ; (b) Γ vs E for composites
(Δ ; DBAB-B, \square ; EHOB-TB, \circ ; EHOB-B)

References

- [1] S. Ducharme, J.C. Scott, R. J. Twieg, and W. E. Moerner, *Phys. Rev. Lett.* 66, 1846 (1991).
- [2] a; P. Strohriegl, *Makromol. Chem., Rapid Commun.* 771, 7(1986) b; P. Lux, P. Strohriegl, H. Höcker, *Makromol. Chem.*, 188, 811(1987).
- [3] a: P. V. Bedworth, Y. Cai, A. Jen, and S. R. Marder *J. Org.Chem.*, 2240, 61(1996) b: S. Song, B. R. Cho, and N. Kim, *Chem. Mater.*, 1406, 11(1999).
- [4] A. Grunnet-Jepsen, C. L. Thompson, and W. E. Moener, *J. Opt. Soc. Am. B* 15, 905(1998).
- [5] R. Bittner, C. Brauchle, and K. Meerholz. *Appl. Opt.* 2843, 37(1998).