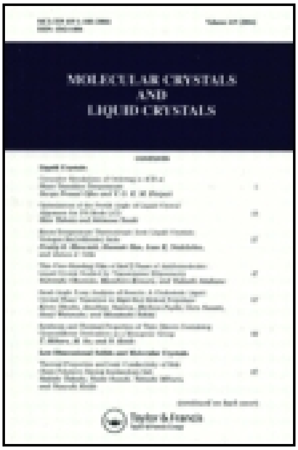

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Chromophores for Polymeric Photorefractive Composites

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Chromophores for Polymeric Photorefractive Composites

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A series of NLO chromophores based on alkylamine-substituted Indole ring were synthesized by varying the strength of electron-acceptor. Photorefractive composites consisted of carbazole-substituted polysiloxane as photoconducting host, doped with prepared NLO molecules and photosensitizer. Electro-optic and photorefractive properties of composites were discussed.

Keywords: photorefractive; electro-optic; chromophore; Indole

INTRODUCTION

The photorefractive effect is a spatial modulation of the refractive index due to charge redistribution in material with optical nonlinerarity.[1] In this work, the influence of chromophore on electro-optic (EO) activity

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and photorefractive (PR) properties were investigated.

EXPERIMENTAL

Carbazole-substituted polysiloxane (PSX, Tg = 51°C) and NLO chromophores were synthesized, as given in Figure 1. Polymer composites consisted of PSX (79 or 69 *wt* %), chromophore (20 or 30 *wt* %), and TNF (Kanto Chemical Co., Inc., 1 *wt* %).

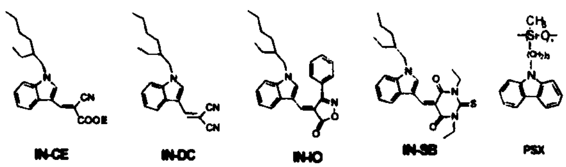


FIGURE 1 Chemical structures of molecules.

The EO activity of composites was determined upon the application of DC field at 632.8 *nm* by a transmission ellipsometric technique. PR performance was characterized by a two-beam coupling (2*BC*) experiment.[2]

RESULTS AND DISCUSSION

The increase of absorption due to chromophore were very low for all PR composites at 632.8 *nm*, as expected from λ_{max} of chromophores (Table1). The calculated result of chromophores using MOPAC shows that EO property is likely to be in the order of IN-DC, IN-SB > IN-IO > IN-CE, as shown in Table 1. Figure 2 shows that IN-CE composites are lower EO response than the other composites, which is in good agreement with MOPAC results. IN-DC composites show the largest electro-optic response among chromophores prepared in this work.

TABLE 1 Molecular parameters of NLO chromophores

NLO	λ_{max}[a] (*nm*)	μ[b] (*D*)	β[b] (10^{-30} *esu*)	$\Delta\alpha$[b] (10^{-23} *esu*)
IN-CE	386	6.83	8.67	1.78
IN-DC	400	6.95	15.0	3.64
IN-IO	438	5.52	16.7	3.99
IN-SB	440	7.08	16.0	5.59

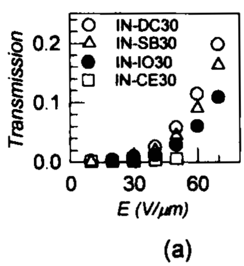
[a]in CH_2Cl_2, [b]Calculated from MOPAC

IN-SB30 composite shows the comparable value with IN-DC30 composite. The low transmission for IN-SB20 composite is probably related to the restricted mobility of medium at *room temperature*. (see *Tg* of composites in Table 2) As shown in Figure 3, the *in-situ* poling

TABLE 2 Glass transition temperature (°*C*) of composites

NLO	IN-CE	IN-DC	IN-IO	IN-SB	P-IN-SB[a]
20 %	25	25	38	42	15
30%	17	15	34	36	-

[a]plasticized by 15 *wt %* of plasticizer, butyl benzyl phthalate



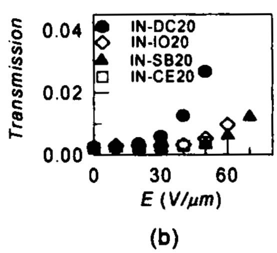


FIGURE 2 *T* vs. *E* for PR composites. (a) [NLO] = 30 wt %; (b) [NLO]=20 wt%.

of IN-SB20 composites is very inefficient, different from IN-DC20 composite (*Tg* ~ room temperature). With lowering *Tg* of IN-SB20 composite by the addition of plasticizer, chromophore of composite is aligned efficiently. This observation clearly demonstrates that chromophore mobility, which is limited by viscosity of medium, must be sufficiently high at *room temperature*, in order to obtain efficient PR composite.

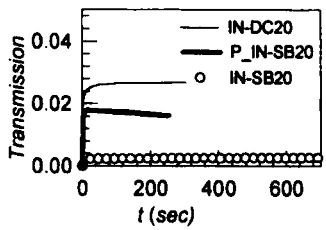


FIGURE 3 *T* vs. *t* for composites at 50 *V/μm*.

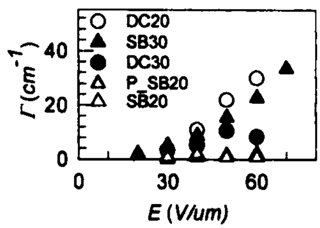


FIGURE 4 *Γ* vs. *E* for PR composites.

As given in Figure 4, IN-DC20 and IN-SB30 composites exhibit the high photorefractive properties, reflecting the relationship that gain is proportional to EO coefficient (r_{eff}), *i.e.*, $\Gamma \propto r_{eff}E_{SC}$. However, IN-DC30 and plasticized IN-SB20 composites show inferior photorefractive properties. This behavior probably appears from the reduction in space-charge field.[2]

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[2] R. Bittner, T. K. Daubler, D. Neher, and K. Meerholz, *Adv. Mater.*, **11**, 123 (1999).