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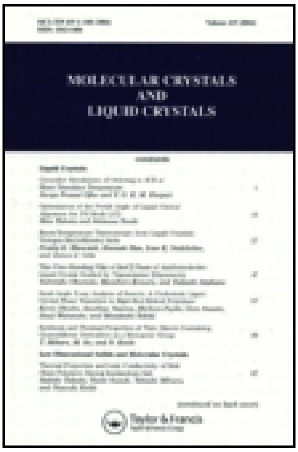

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Synthesis and Characterization of Hole-transport Materials in Polysiloxane

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Synthesis and Characterization of Hole-transport Materials in Polysiloxane

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ABSTRACT Triphenylamine(TPA) substituted polysiloxane was synthesized as the hole-transporting material. Field dependence of the hole mobility and photoconductivity were measured using the time-of flight and simple *DC* photocurrent measurement, respectively. We demonstrated that the film of polysiloxane with pendant TPA units higher hole mobility (3.2×10^{-5}cm^2/Vsec at E= 6×10^5) than that of the conventional poly(*N*-vinylcarbazole) and carbazole substituted polysiloxane. Further experiments are required to test these new materials as hole transporting layers in photorefractive and electroluminescent devices.

KEYWORDS Hole-transport; Photoconductivity; Triphenylamine; Polysiloxane

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INTRODUCTION

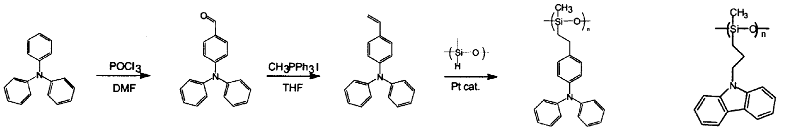
The hole-transporting materials offer the variety of important applications, such as xerography, photorefractive, EL devices and solar energy conversion.[1] The performance of these materials has been improved in the past year and focused on the binding of hole-transporting units, which possess higher hole mobility, good processability, and stability. In this work, triphenylamine substituted polysiloxane was synthesized for highly efficient hole-transporting material.

EXPERIMENTAL

Materials

A carbazole-substituted poly(siloxane) was synthesized by the procedure described in the previous paper.[2] The a novel vinyl monomer containing the triphenylamine molecule, *N,N*-diphenyl-*N*-(4-vinylphenyl)amine was synthesized by a Wittig reaction of triphenylamin aldehyde with methyltriphenylphoponium iodide followed by a Vilsmeir formylation method. A triphenylamine-substituted polysiloxane was synthesized by the hydrosililation method. The thin film fabrication was used by a spin coating method. For the photoconducting experiment, polymer (99 wt%) and 1,4,7-trinitro-9-fluorenylidene (TNF, 1%) were dissolved in monochlorobenzene and for the TOF experiment, only the polymer matrix was dissolved in solvent.

The photoconducting property and hole mobility were investigated by simple DC photocurrent measurement using He-Ne laser and time of flight (TOF) technique was carried out to study at N_2 larer.[3]



PSX-C2-TPA PSX-C3-Cz

Scheme 1. Synthetic procedure of PSX-C2-TPA and PSX-C3-Cz

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RESULTS AND DISCUSSION

Triphenylamin substituted polysiloxane (PSX-C2-TPA) was synthesized by hydrosililation. The synthetic procedure was illustrated in scheme 1. The general properties of the polymers were summarized in Table 1. Particularly, PSX-C3-Cz has lower glass transition temperature (T_g) than PSX-C2-TPA due to the length of side chain.

TABLE 1. The properties of synthetic polysiloxanes

Polymer	absorption λ_{max} a) (nm)	Fluorescence λ_{max} b)	T_g c)(°C)	σ_{ph} d) (10^{-12}S/cm)	μ e) (cm^2/Vs)
PSX-C3-Cz	334 and 348	308	51	1.80	4.3×10^{-6}
PSX-C2-TPA	384	400	123	0.52	3.2×10^{-5}

a) From UV-Vis. absorption spectra of polymer films. b) Emission spectra of polymer film. Exicted at 300 nm c) Measured by DSC under N_2 (10°C/min) d) $E=3 \times 10^5$, 633nm, with TNF (1 *wt.* %) e) $E=5 \times 10^5$, 337nm, without TNF

The photoconductivity (σ_{ph}) was determined by simple DC photocurrent measurement. When the beam with the intensity of 1.46 mW/cm^2 intensity was irradiated on polymer films, current density increased remarkably, as shown Figure 1(a). Photoconductivities were listed in TABLE 1. All of these conductivity values under illumination were significantly higher than those in dark. Interestingly, the photoconductivity of PSX-C3-Cz was higher than that of PSX-C2-TPA. This may be attributed to the more effective formation of charge transfer complex with TNF and the more generation of the charge carrier.

A typical hole current recorded on a PSX-C2-TPA film at a field $E = 5 \times 10^5$ V/cm is shown in Figure 1(b). The initial current spike is followed first by a constant current plateau (about 25 ~ 30ms). This corresponds to the hole transport with a time-dependant drift velocity. The subsequent decrease in the current is caused by the holes reaching the

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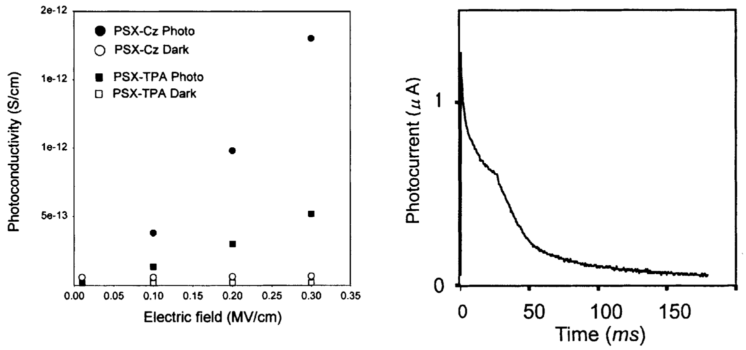
counter electrode where they recombine with electrons. According to their hole mobility values at an electric field of 5 × 10^5 V/cm were listed in TABLE 1. The mobility of PSX-C2-TPA was found to be about tenfold higher at the same field strength. The experimental results for hole mobility were in good agreement with general hole mobility of hole-transporting molecules.[4]



(a) (b)

FIGURE 2 (a) Photo and dark conductivity of polymer ; (b) Typical transient photocurrent for a PSX-C2-TPA film.

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