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Study of the Photo-Alignment using Photo-Sensitive Polyimide (PI) Containing Chalcone Moiety

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Photosensitive polyimide containing chalcone moiety as a photo-alignment layer in LCD is synthesized. Chalcone monomer is prepared through William's reaction and DOCDA-DAP is polymerized via one-step imidization followed by introducing the prepared chalcone moiety. The solution and film of the photosensitive polyimide are irradiated with UV light and characterized by UV-vis. and FT-IR spectroscopies.

Keyword chalcone, photo-sensitive polyimide, photo-dimerization

INTRODUCTION

Much attention has been paid to photo aligning ability to orient liquid crystals homogeneously after being irradiated with linearly polarized UV light and these photo-alignment techniques[1-3] are expected to replace the conventional rubbing method effectively. The chalcone derivatives[4-5] have been known to dimerize efficiently. Especially, PI films have also been widely used as liquid crystal alignment layers. We synthesized photosensitive polyimides containing chalcone moiety as a photo alignment layer material and characterized by UV-vis. and FT-IR spectroscopies.

EXPERIMENT

Chalcone derivatives are prepared by the coupling reaction of compound 1 with compound 2 in the mixture of aq. NaOH solution and methanol as shown in Figure 1. DOCDA-DAP polyimide is prepared via one-step imidization reaction of DOCDA (5-(2,5-dioxotetrahydro furyl)-3-methyl-3-cyclohexene-1,2-dicarboxylic anhydride) and DAP (1,4-diaminophenol) using isoquinoline (5 wt%) in m-cresol. Finally, we synthesized photocrosslinkable polyimides by introducing prepared chalcone derivatives as a side chain into the backbone of DOCDA-DAP as shown in Figure 2. These products were confirmed with FT-IR, UV-vis. spectroscopy and NMR. The polyimide is spin- coated and irradiated with the UV light.

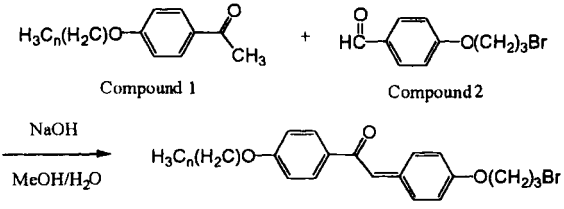


FIGURE 1. Synthesis of Chalcone derivatives.

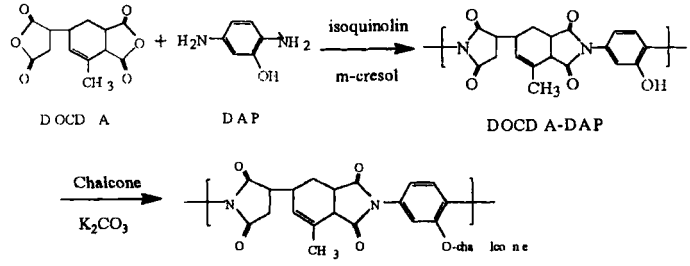


FIGURE 2. Synthesis of Photo-sensitive polyimide.

RESULTS AND DISCUSSION

The synthesized chalcone monomer, polyimide and polyimide containing chalcone were confirmed by FT-IR spectroscopy and ^{1}H-NMR which corresponded to their structures. The inherent viscosity of prepared polyimide is 0.517. The UV-vis. spectra of chalcone contained polyimide solution show 274 nm-absorption band and a shoulder at 354 nm(Figure 3). After irradiation with UV light (the intensity of UV lamp: 1.0 mW/cm^2), the intensity of two absorption peaks reduced significantly in less than a few minutes at room temperature.

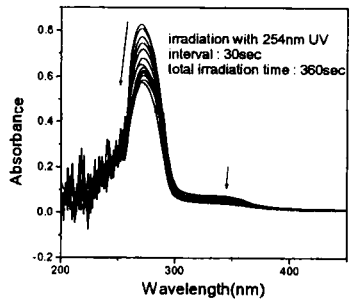
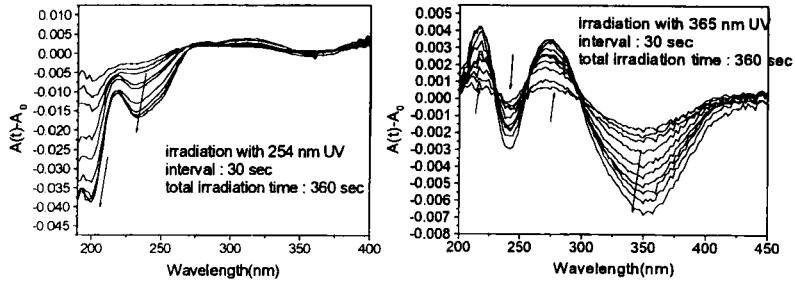


FIGURE 3. UV-vis. spectra of photosensitive polyimide.



(a) (b)

FIGURE 4. Differential spectra of chalcone contained polyimide film irradiated with 254 nm(a) and 365 nm(b) light.

In solution state, the spectrum after irradiation with 254 nm UV light is similar with that of 365 nm irradiation. But, in the case of film, the tendency of photo-reaction is different from each other. Variations in the differential spectra $A(t)-A_0$ are shown in Figure 4 as a function of irradiation time. In the spectra after irradiation of 365 nm light, isobestic point indicates that cis-trans isomerization is the onlyprocess, whereas absorption spectra after 254 nm-irradiation exhibit no isobestic point indicating that the C=C bond of chalcone moiety disappears by dimerization not by isomerization. Also, we observed that the intensity of the conjugated C=O peak and C=C peak of chalcone moiety in the FT-IR spectra decreased by irradiation of 254 nm UV light. With this polyimide film, LC cells were fabricated and LC molecules were aligned perpendicular to polarizer axis.

Acknowledgment

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