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Photoconductivity of Polyimide Films Containing Diphenyl-benzidine Structure and Relations with the Electron-withdrawing Properties of Dianhydrides

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Introduction

We have previously investigated the photoconductivity (PC) of various polyimides (PIs) consisting of diphenyl-benzidine structure and reported that charge transfer transition ability (CT interaction) between the diamine and dianhydride moieties, molecular chain orientation and aggregation structures are essential to enhance the PC. The CT interaction can be strengthened with enhancing the electron-accepting ability of dianhydride and the electron-donating ability of diamine moieties. In this study, we synthesized novel PI films based on variable fluorinated dianhydrides, having strong electron-accepting abilities (Fig. 1). We investigated the relationship between PC and the electron-withdrawing properties of dianhydrides.

Experiment

Photocurrent was measured by applying a positive voltage on the ITO electrode with dispersed light irradiated from longer to shorter wavelength. Oientation function defined by $P_{200}=<3\cos^2\theta-1>/2$ was evaluated refractive index by prism coupler (Metricon PC-2010) and dichroic ratio by polarized ATR-FTIR (JASCO FT/IR-4200).

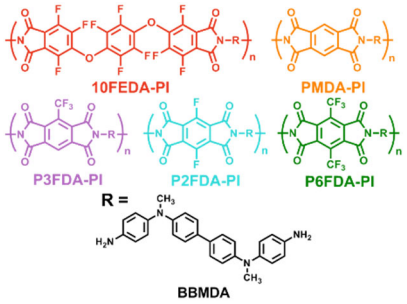

Fig. 1 Chemical structures of target PIs.

Results and Discussion

Photocurrent property in Fig. 3 exhibit clear relation with order of absorbance intensity in longer wavelength region than 500 nm shown in Fig. 2. Photocurrent increase with increasing absorption intensity; that is became much higher in shorter wavelength. At 420 nm in Fig. 3, photocurrent apparently depend on the order of electron-withdrawing strength of dianhydrides except for 10FEDA-PI. This phenomenon was attributable to difference in transport efficiency, 10FEDA-PI is remarkably transport compared with other PIs ansd carrier can generated deeply inside the film, whereas the other PIs exhibited strong absorption and carrier generated near the surface, resulting much longer transport distance.

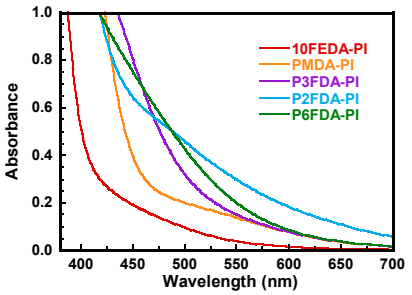

Fig. 2 Absorbance spectra of PI films.

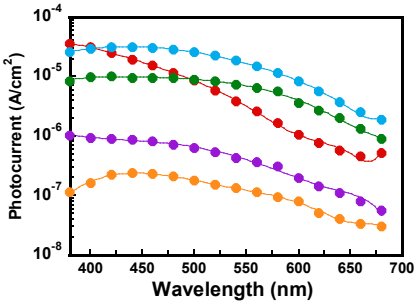

Fig. 3 Photocurrent spectra of PI films.

References

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2) C. Takemasa; T. Chino; S. Fukuchi; S. Asai; R. Ishige; S. Ando, Polym. Prep. Japan, 66(2), 3Z03(2017).