Effects of CT Interactions on the Photoconductive Properties of Fluorine-containing Polyimide Films

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Photoconductive property of polyimides[1] (PIs) is interesting from the view point of generation and transportaion of electric charge. PIs containing triphenylamine (TPA) structures were reported to represent significant photo-conductivity.[2] We have recently reported that the UV/vis absorptions and the photocurrents of TPA-containing PIs increase with increasing the electron affinity (*EA*) of the dianhydride moiety, which is due to the enhanced charge transfer (CT) interactions.[3] In this study, the photo-conductive properties of PI films derived from three dianhydrides having large *EA*s and a TPA-diamine was investigated. PI films (Fig.1) were formed on ITO substrates, and silver electrodes (ϕ=1 mm) were directly formed on the PI films. Photocurrent in the thickness direction was measured at 50 kV·cm^{-1} with varying irradiation wavelengths. As seen in Fig.2(a), the UV/vis absorptions of PI films in the visible region (400−650 nm) increase with increasing the *EA*s of dianhydrides, reflecting the enhanced CT interactions, though the photocurrent did not show clear correlation with the CT in Fig.2(b). Despite the largest *EA* of P6FDA, P6FDA/DATPA film showed lower photocurrent than P3FDA/DATPA. The carrier generation in polymers is thought to be influenced by the processes of 'exciton generation' and 'charge separation'. In the P6FDA/DATPA film, interchain distance should be significantly increased by the steric hindrance from two −CF_3 groups at the symmetrical positions, and thus the efficiency of carrier transfer between PI chains is suppressed. For the design of photo-conductive PIs, not only enhancement of CT interactions but also facility in charge separation is an important factor.

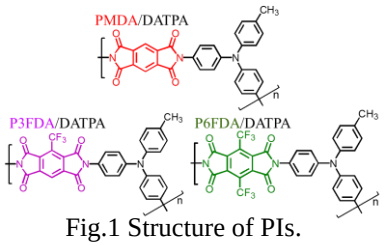

Fig.1 Structure of PIs.

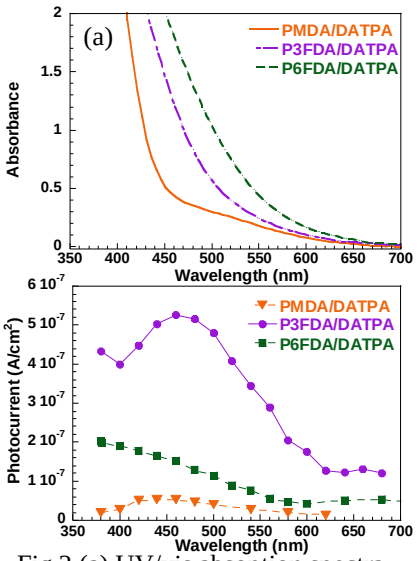

Fig.2 (a) UV/vis absoption spectra and (b) photocurrent spectra of PIs.

References

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