

Synthesis and Properties of Multi-color Fluorescent Polyimides Exhibiting High Optical Transparency and Large Stokes Shifts

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We have been developing highly fluorescent polyimides (HFPIs) with the aid of TD-DFT calculations of their electronic structures (Fig.1).^{1,2} Recently, we have proposed a novel molecular design concept for multicolor HFPIs based on the excited-state proton transfer (ESIPT) mechanism.³ The UV/Vis absorption and fluorescence spectra of imide compounds with/without intramolecular hydrogen bonding between hydroxyl (–OH) and imide carbonyl groups were extensively investigated. By introducing –OH into pyromellitic moiety, the lowest energy CT(π - π^*) transition was readily converted to LE(π - π^*) transition. Upon irradiation, the *enol* form of P2HyDA was immediately converted to the *keto* form through LE(π - π^*) transition followed by intramolecular proton transfer. The excited *keto* form emits a strong red-color fluorescence via ESIPT at 642 nm by excitation at 410 nm (Fig.2). The Stokes' shift is as large as 8800 cm^{-1} . Moreover, the fluorescence of –OH substituted imide compounds (Fig.3) and PIs shows significant sensitivity to basicity (pH) due to deprotonation at the –OH group. The strong fluorescent emission at longer wavelengths by excitation in the near-UV region is applicable to solar-light converters for Si-type solar cells and agricultural applications.

References

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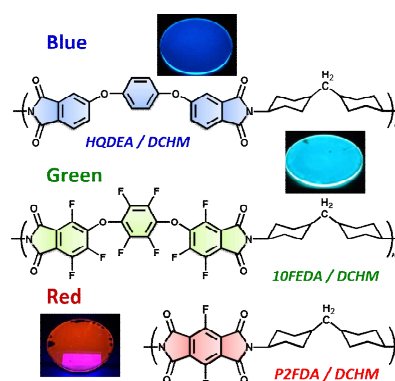


Fig.1 Multi-color fluorescent PIs.

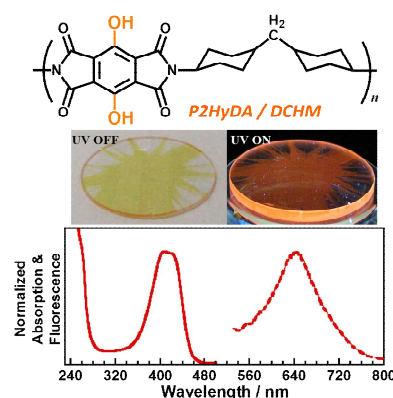


Fig.2 Red-emitting PI via ESIPT exhibiting a large Stoke's shift.

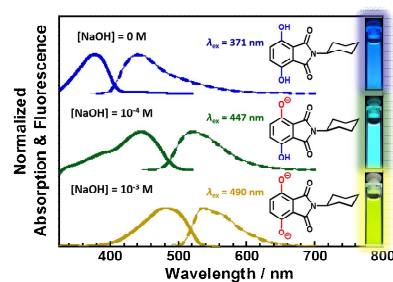


Fig.3 Changes in fluorescent colors caused by deprotonation.