

Synthesis and Fluorescence Properties of Acylamino-substituted N-cyclohexylphthalimides

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I. INTRODUCTION

Fluorescent polymeric materials have attracted much interests because of their potentials for applications such as spectrum converter which enhances the Si-type solar cell performance and promote the growth of crops. However, conventional fluorescent polymers such as polyfluorene derivatives do not have sufficient chemical stability for long-term period use in outdoor environment.

Polyimide (PI) is a class of polymers synthesized from a dianhydride and a diamine. It is well-known for its high thermal stability and excellent mechanical properties. Previously, we have reported a molecular design strategy for synthesizing highly fluorescent PIs[1]: (1) Use of alicyclic diamines, (2) Use of dianhydrides with extended conjugation. Further, we recently reported a highly fluorescent PI containing hydroxyl group in the dianhydride moiety as π -electron donor which extends conjugation [2].

In this study, four kinds of model compounds (Fig. 1) for fluorescent PIs having acylamino groups as π -electron donating groups were synthesized, and the effects of intramolecular hydrogen-bonding (IHB) between acylamino N-H group and imide C=O group on their fluorescence properties were evaluated.

II. EXPERIMENTAL

The absorption spectra were measured with Hitachi U-3500 spectrophotometer, and the fluorescence spectra were measured with Hitachi F-4500 spectrofluorometer. Fluorescence quantum yield (Φ) was estimated using an integrating sphere. The solution concentrations of compounds for measurements were set to 5.0×10^{-5} M.

III. RESULTS AND DISCUSSION

All the synthesized compounds exhibited blue light emissions (410–422 nm) under UV lamp in CHCl_3 solution. The absorption and fluorescence spectra as well as Φ s of the compounds in CHCl_3 solution are shown in Fig. 2. It should be noted that the Φ s of the two compounds forming IHB (3NAcAPI, 3NChAPI) are much lower than those of the compounds without forming IHB (4NAcAPI and 4NChAPI). This result suggests that there exists a radiationless deactivation process relating to IHB.

Furthermore, Fig. 2 shows that substitution of bulky cyclohexyl group at the acyl position effectively increases their Φ s. This implies that such bulky substituent group at acyl position inhibits radiationless deactivation process.

In conclusion, the fluorescence quantum yields of acylamino-substituted N-cyclohexylphthalimides are increased by addition of bulky cyclohexyl group at acyl position but decreased by formation of intramolecular hydrogen-bonding.

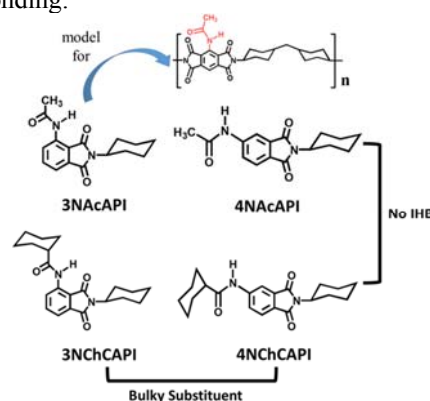


Fig. 1 Chemical structures of model compounds.

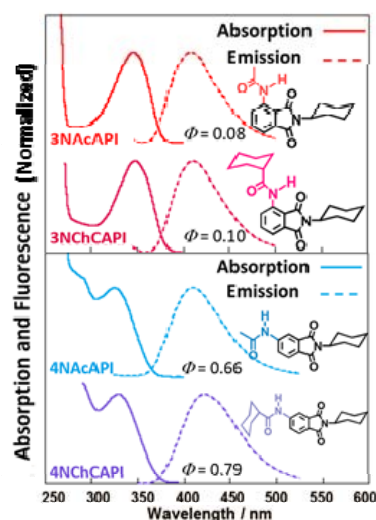


Fig. 2 Absorption and fluorescence spectra and Φ s of the model compounds.

REFERENCES

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