Highly Fluorescent Properties of Imide Compounds Having Two Intra-molecular Hydrogen Bondings

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Abstract: To clarify the effects of hydroxy (-OH) groups on the fluorescence properties of imide compounds, a *N*-cyclohexylphthalimide compound (DHNHPI) having two -OH groups was newly synthesized. DHNHPI exhibits strong fluorescence compared to the imide compound having one -OH group (HNHPI). The deprotonated species of DHNHPI was observed under basic conditions using DBU as an organic basic agent, and corresponding strong green fluorescence was observed. The introduction of two -OH groups into phthalimide compound leads to significant enhancement of fluorescent and environmental sensitivity.

1. Introduction

Fluorescent materials can be used in many fields such as organic light emitting displays for liquid crystalline displays and spectrum converters for solar cells (Fig.1). Recently, polyimide, a well-known super engineering plastic which exhibits high thermal and chemical stability, has been attracted much interests as a new class of thermally stable optical materials. Previously, we have proposed a molecular design concept for highly fluorescent polyimides [1]. Moreover, we have found that an imide compound having a hydroxy (−OH) group (HNHPI Fig.2b) exhibits more enhanced emission compared with *N*-cyclohexylphthalimide (NHPI, without −OH groups, Fig.2a). This should be due to changes in electronic states caused by intra-molecular hydrogen bonding [2].

In this study, a novel imide compound (DHNHPI Fig.2c) having two −OH groups was synthesized to clarify the effects of the second −OH groups to the fluorescence properties of phthalimide compounds.

2. Experimental

The fluorescence spectra were measured using Hitachi F-4500 spectrofluorometer and fluorescence efficiencies estimated using an integrating sphere. The solution concentrations for measurements were set to 1.0×10^{-5} M.

3. Results and Discussion

The fluorescence efficiencies of NHPI, HNHPI and DHNHPI are shown in Fig.2. It should be noted that DHNHPI showed stronger emission than that of HNHPI. Fig.3 shows the fluorescence spectra of DHNHPI under basic conditions using DBU as an organic basic agent. When the concentration of DBU is higher than 10^{-2} M, DHNHPI's fluorescence color was changed from blue to green, which should be originated from its deprotonated form (see Fig.3). In conclusion, the incorporation of −OH groups into imide compounds is a useful and attractive tool for enhancing their fluorescence properties, and moreover it makes imide compounds more sensitive to environmental conditions.

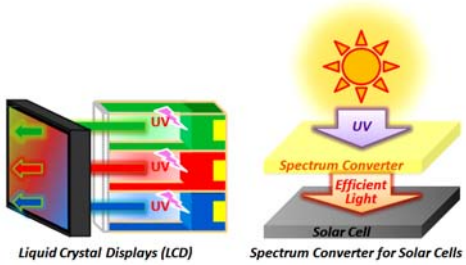

Figure 1. Schematic illustration of fluorescence materials

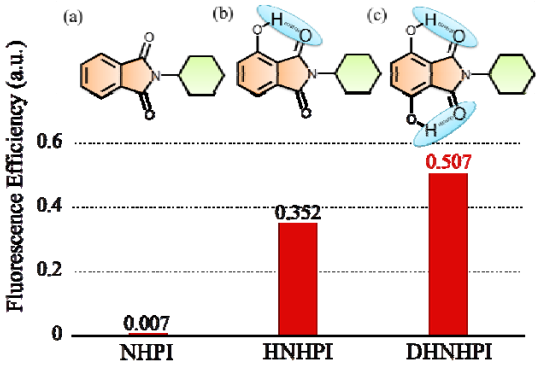

Figure 2. Chemical structures and fluorescence intensities of the three imide compounds

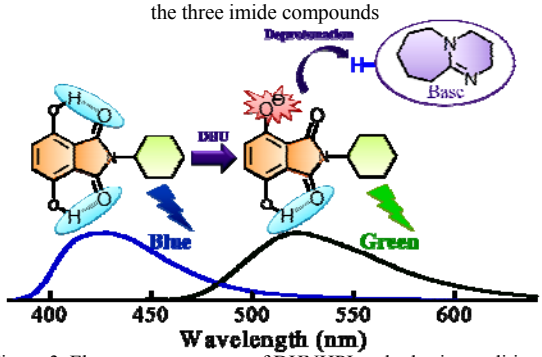

Figure 3. Fluorescence spectra of DHNHPI under basic condition.

4. References

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[2] J. Wakita, S. Inoue, N. Kawanishi, S. Ando, "Excited-State Intramolecular Proton Transfer in Imide Compounds and its Application to Control the Emission Colors of Highly Fluorescent Polyimides", *Macromolecules*, vol. 43, pp. 3594-3605, 2010.