



Mechanofluorochromic behavior of anthracene-based acylhydrazone derivatives

Zhiming Li^{a, b}, Binglian Bai^a, Jue Wei^{a, *}, Haitao Wang^b, Qing Chai^a, Caijuan Sun^b, Min Li^{b, **}

^a College of Physics, Jilin University, Changchun 130012, PR China

^b Key Laboratory for Automobile Materials (JLU), Ministry of Education, Jilin University, Changchun 130012, PR China

ARTICLE INFO

Article history:

Received 24 March 2018

Received in revised form

17 May 2018

Accepted 22 May 2018

Available online 23 May 2018

Keywords:

Anthracene-based derivatives

Mechanofluorochromic

Fluorescence

Aggregation

ABSTRACT

Two anthracene-based derivatives, having one or two acylhydrazone branches attached on the anthracene, namely, asymmetrical AHP-1 and symmetrical AHBP-1 were designed. These compounds exhibited mechanofluorochromic behavior with the emission colors reversibly changing upon grinding and recrystallizing. The mechanofluorochromic mechanism was explored and ascribed to the crystalline-amorphous phase transformation. In addition, the red-shifted extent of fluorescent emission of the ground AHBP-1 samples was more than that of AHP-1.

© 2018 Elsevier Ltd. All rights reserved.

1. Introduction

The solid-state photoluminescent materials have attracted intensive interest.^{1–3} In particular, the mechanofluorochromic materials that exhibit a reversible fluorescent color change by exerting mechanical stimuli have received substantial attention owing to their fundamental importance and promising applications in sensors, memory devices, security ink.^{4–8}

As the first mechanofluorochromic aggregation-induced emission (AIE) compound was reported by Park et al., in 2010,⁹ compared to non-AIE mechanofluorochromic materials,^{10–13} many AIE mechanofluorochromic materials have been reported,¹⁴ such as tetraphenylethene^{15,16} and 9,10-divinylanthracene derivatives.^{17–20} In fact, the slight differences in molecular structure will induce distinct mechanofluorochromic behaviors. For example, the mechanofluorochromic properties of 9,10-divinylanthracene derivatives can be influenced by the isomerization of endgroups,¹⁷ alkyl length,¹⁸ alkoxy-position¹⁹ and the types of end-group,²⁰ etc. These results confirm the complexity of the structure-property relationship of mechanofluorochromic materials.

Recently, the mechanofluorochromic behaviors of amide hydrogen bonding derivatives have been investigated widely,^{21–27} whereas the studies showing mechanochromic luminescence based on the acylhydrazone derivatives are still limited.^{28–30} Based on these ideas, two anthracene-based acylhydrazone derivatives, asymmetrical AHP-1 and symmetrical AHBP-1 (Scheme 1) were designed. Different numbers of acylhydrazone branches attached on the anthracene were used to study the relationships between the molecular structure and the photo-physical properties as well as mechanofluorochromic behaviors.

2. Experimental section

2.1. Synthesis of AHBP-1 and AHP-1

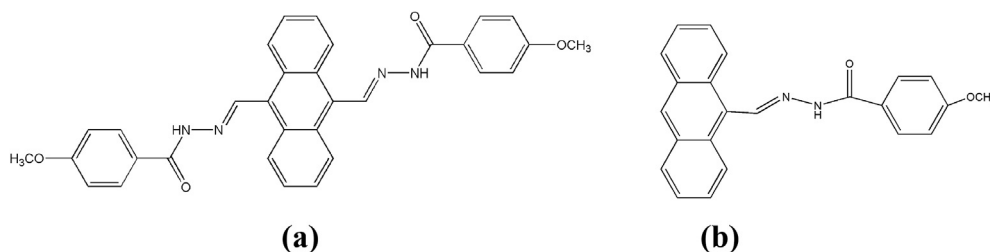
AHBP-1 was synthesized by having 4-methoxybenzhydrazide (1.0 g, 6.0 mmol) reacting with anthracene-9,10-dicarboxaldehyde (0.71 g, 3.0 mmol) in ethanol (100 mL) under reflux condition for 4 h. The crude product was isolated and purified by cleaning from ethanol-chloroform (9:1) mixed solvents (100 mL) for further ¹H NMR, FT-IR measurements and elemental analysis (m.p. = 360 °C, yield = 73%, because of the poor solubility of AHBP-1, the data of ¹³C NMR cannot be obtained.). Using the same method, compound AHP-1 was synthesized and characterized.³¹

¹H NMR (300 MHz, DMSO-*d*₆), (ppm, from TMS): 12.09 (s, 1H),

* Corresponding author.

** Corresponding author.

E-mail addresses: weijue@jlu.edu.cn (J. Wei), minli@mail.jlu.edu.cn (M. Li).



Scheme 1. The molecular structures of (a) AHBP-1 and (b) AHP-1.

9.62 (s, 1H), 8.74–8.69 (m, 2H), 8.06–8.01 (d, 2H), 7.74–7.69 (m, 2H), 7.16–7.12 (d, 2H), 3.99 (s, 3H).

FT-IR (pellet, cm^{-1}): 3178, 3031, 1646, 1607, 1547, 1511, 1416, 1392, 1347, 1289, 1260, 1187, 1150, 1112, 1072, 1022, 841, 811, 747, 681.

Elemental analysis: calculated for $\text{C}_{32}\text{H}_{26}\text{N}_4\text{O}_4$, C, 72.44; H, 4.94; N, 10.56. Found: C, 72.60; H, 4.98; N, 10.14.

2.2. Characterization

^1H NMR spectra were recorded with a Varian Unity 300 spectrometer (300 MHz), using dimethyl sulfoxide- d_6 as solvent and

tetramethylsilane (TMS) as an internal standard ($\delta = 0.00$). Field emission scanning electron microscopy (FE-SEM) images were taken with a JSM-6700F apparatus. X-Ray diffraction (XRD) was carried out with a Bruker Avance D8 X-ray diffractometer. FT-IR spectra were recorded with a Perkin-Elmer spectrometer (Spectrum One B) and the sample was cast onto silicon wafer for FT-IR measurement. UV-vis absorption spectra were recorded on a Shimadzu UV-2550 spectrometer, and the photoluminescence was measured on a Perkin-Elmer LS 55 spectrometer. Solid state PL efficiencies were measured using an integrating sphere (Fluorescence spectrophotometer SENS-900).

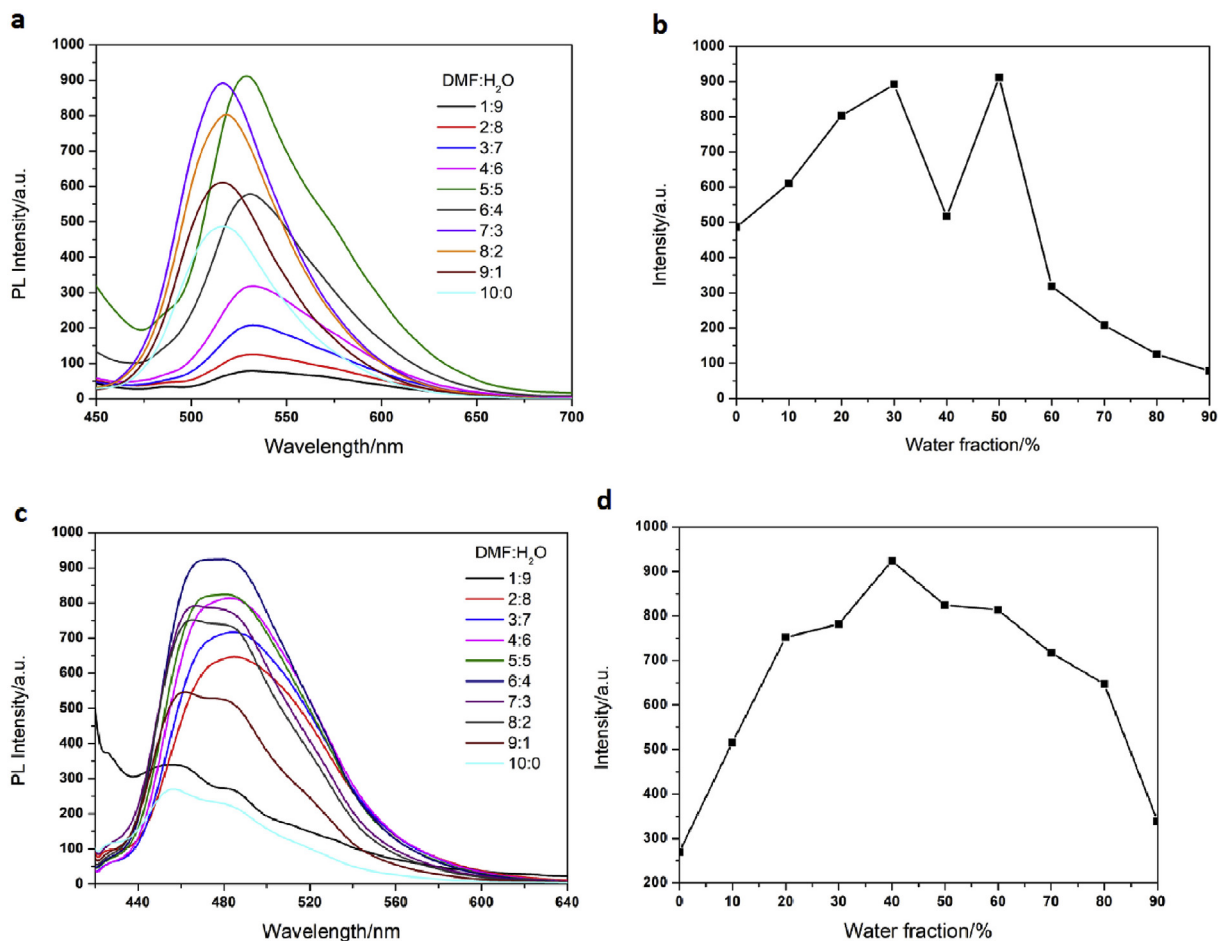


Fig. 1. PL spectra of (a) AHBP-1 and (c) AHP-1 in DMF-water mixtures with different water fractions, (b) AHBP-1 and (d) AHP-1 depict the changes in PL peak intensities under different water fractions.

Download English Version:

<https://daneshyari.com/en/article/7826896>

Download Persian Version:

<https://daneshyari.com/article/7826896>

[Daneshyari.com](https://daneshyari.com)