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RESEARCH ARTICLE

SYNTHESIS AND CHARACTERIZATION OF AN Al^{3+} -SELECTIVE PROBE BASED ON NAPHTHALIMIDE DERIVATIVE

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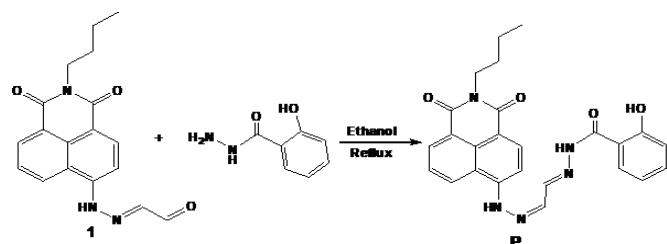
Al^{3+} , Fluorescent probe, Benzoyl hydrazine, Naphthalimide.

ABSTRACT

An Al^{3+} -sensitive fluorescent probe P was designed and characterized in this work. Study showed that this probe has better selective to Al^{3+} compared to other tested cations and anions. UV-vis spectra confirmed the reaction of P with Al^{3+} , and the possible binding mode was also proposed.

INTRODUCTION

Increasing exposure to free aluminum ions (Al^{3+}) poses a severe threat to biospheres and human health because of human activities in the environment. According to the WHO report, the average daily human intake of aluminium is approx. 3–10 mg/d, and the tolerable weekly aluminium intake in the human body is estimated to be 7 mg/kg body weight [1]. So the detection of Al^{3+} is of great important [2]. Among the detection methods of Al^{3+} [3], the fluorescent probe method has the advantages, such as good selectivity and sensitivity [4–6], and many Al^{3+} -selective fluorescent probes have been reported [7–9]. Based on the above-mentioned reasons, an Al^{3+} -selective fluorescent probe derived from naphthalimide was designed and characterized. The synthesis route was shown in Scheme 1.



Scheme 1. Synthesis route of P

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EXPERIMENTAL SECTION

Reagents and Instruments: All reagents and solvents are of analytical grade and used without further purification. Fluorescence emission spectra were conducted on a Hitachi 4600 spectrofluorimeter. UV-Vis spectra were obtained on a Hitachi U-2910 spectrophotometric. Nuclear magnetic resonance (NMR) spectra were measured with a Bruker AV 400 instrument and chemical shifts are given in ppm from tetramethylsilane (TMS).

Synthesis of Probe P

Compound 1 was synthesized according to the reported method [10]. Compound 1 (0.15 mmol) and Salicylhydrazine (0.15 mmol) were mixed in ethanol (40 mL) and stirred under reflux for 5 h. After the reaction was completed, the solution was cooled to room temperature and poured into 200 mL water, the precipitate so obtained was filtered and dried in vacuum. The product was used directly. Yields: 82.5%. ¹H NMR: 11.94 (s, 1H), 11.70 (s, 1H), 8.74 (d, 1H), 8.48 (d, 1H), 8.38 (d, 1H), 8.22 (d, 1H), 8.19 (d, 1H), 7.83 (t, 2H), 7.63 (d, 2H), 7.41 (t, 1H), 6.97 (t, 1H), 6.94 (d, 1H), 4.01 (t, 2H), 1.58 (m, 2H), 1.34 (m, 2H), 0.91 (t, 3H).

General Spectroscopic Methods: 1.0 mM stock solutions were obtained by dissolving cations, anions and P in deionized water and DMSO, respectively. The solution was freshly prepared before spectroscopic measurements and the desired

concentration was obtained by diluting the high concentration stock solution.

RESULTS AND DISCUSSION

Selectivity measurements: The selectivity of probe P was detected using fluorescence methods, and the spectra of P (10 μ M) were investigated in ethanol with the addition of respective metal ions (100 μ M) (Figure 1). The testing cations and anions are K^+ , Na^+ , Ca^{2+} , Mg^{2+} , Zn^{2+} , Pb^{2+} , Co^{3+} , Cd^{2+} , Cu^{2+} , Fe^{2+} , Cr^{3+} , Ni^{2+} , Hg^{2+} , Cu^{2+} , Fe^{3+} , Al^{3+} , Ag^+ , ClO_4^- , NO_3^- , CO_3^{2-} , ClO_4^- , Br^- , SO_4^{2-} , I^- and HPO_4^{2-} . From the results we can know that P has good selectivity towards Al^{3+} , and so the proposed P was characterized as an Al^{3+} -selective probe in ethanol solution.

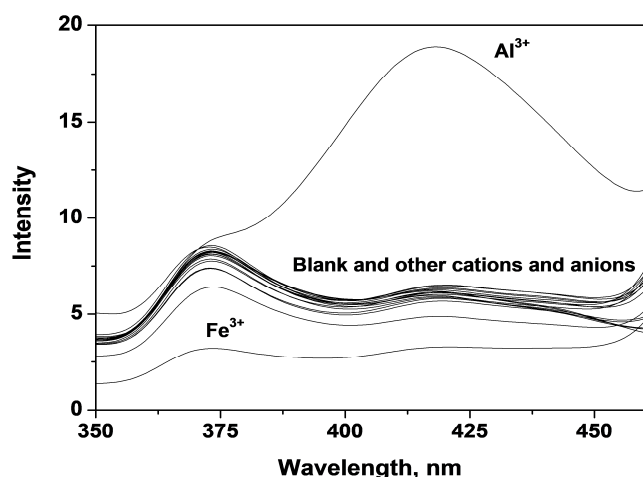


Figure 1. Selectivity measurement P with common cations and anions

Uv-vis spectra of P and P- Al^{3+} : In order to study the reaction of P with Al^{3+} , the Uv-vis spectra was also carried out (Figure 2). The result showed that the absorbance in 475 was enhanced obviously with the addition of Al^{3+} , which also confirmed the reaction of P and Al^{3+} .

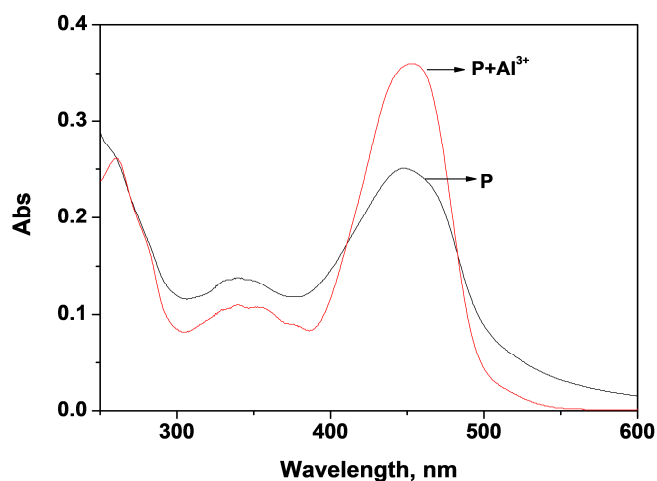
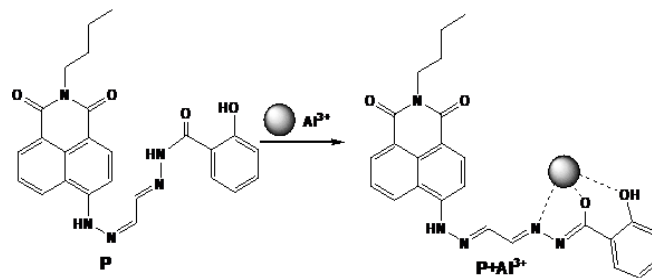


Figure 2. Uv-vis spectra of P and P- Al^{3+} system

Proposed binding mode of P with Al^{3+} : According to the results obtained as above mentioned, the binding mode of P with Al^{3+} was proposed as shown in Scheme 2. The N and O participate in the formation of P- Al^{3+} complex.



Scheme 2. Binding mode of P with Al^{3+}

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