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A Novel Fluorescent Sensor for the Sensitive Detection of Mercury

Fang Ma^{a,b}, Mingtai Sun^{a,b}, Chao Yuan^{a,b}, Jianlei Yao^{a,b} and Suhua Wang^{a,b,*}

^aDepartment of Chemistry, University of Science & Technology of China, Hefei 230026, P. R. China

^bInstitute of Intelligent Machines, Chinese Academy of Sciences, Hefei 230031, P. R. China

Abstract

Mercury pollution is a widespread danger to human health and environment. To developed a effective method for mercury detecting is in high demand. This work demonstrated a novel bright fluorescent molecule DPDTC for the sensing of mercury. The approach was mainly based on the mercury-induced fluorescence turn-off of DPDTC. The probe was prepared by a simple method and exhibited high fluorescence. The fluorescence of DPDTC was very stable and immune to photobleaching. Results showed that DPDTC was a promising tool for mercury detection. Moreover, DPDTC could be immobilized on a paper to prepare a simple and portable sensor which expanded its real application.

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1. Introduction

As one of the most toxic heavy metals, mercury pollution has attracted much attention in environmental and toxicological domains for decades.¹⁻² Inorganic mercury released mainly from industrial sources can be further converted into methylmercury by microorganisms and fish.³ Methylmercury, the most common organic mercury, is more toxic than inorganic mercury because it's lipophilic and easily absorbed by aquatic organisms which finally bioaccumulate in the human body through the food chain leading to severe impact on

* Corresponding author. Tel.: +086-0551-65591812; fax: +086-0551-65591156.

E-mail address: shwang@iim.ac.cn.

human health due to its severe toxicity to the nervous and immune system.⁴⁻⁶

We report herein a fluorescent probe DPDTC and its application in the Hg(II) determination in ethanol/water mixed solution. The probe is designed based on the quenching of fluorescence signals. To the best of our knowledge, this is the first time that utilizes DPDTC to detect Hg(II).

2. Experimental Methods

DPDTC was prepared according to the following procedures. Generally, DPA (1 equiv) and ammonium hydroxide (1.25 equiv) were mixed in MeOH / CHCl₃ (1:1, V/V). The mixture was stirred in an ice bath for 30 min. Then a solution of CS₂ (1.25 equiv) dissolved in the same solvent was dropwise added into the above solution. The mixture was stirred for 12 h at room temperature and the product was obtained.

Hg(II) was added to DPDTC solution to investigate the change of fluorescence of DPDTC. The fluorescence spectra were recorded before and after the addition of Hg(II).

3. Results and Discussion

3.1. Optical Properties of DPDTC

Fluorescence properties of DPDTC were examined in 1:1 EtOH/H₂O solution, as presented in Fig. 1. It's clearly that DPDTC have several excitation bands which centered at 250 nm, 300 nm and 390 nm. And its maximum emission appeared at 505 nm. Several excitation wavelength were applied to excite the fluorescence of DPDTC, and it was found that the intensities of the fluorescence were varied with the excitation wavelength. And in the next study, 300 nm was selected as the excitation wavelength.

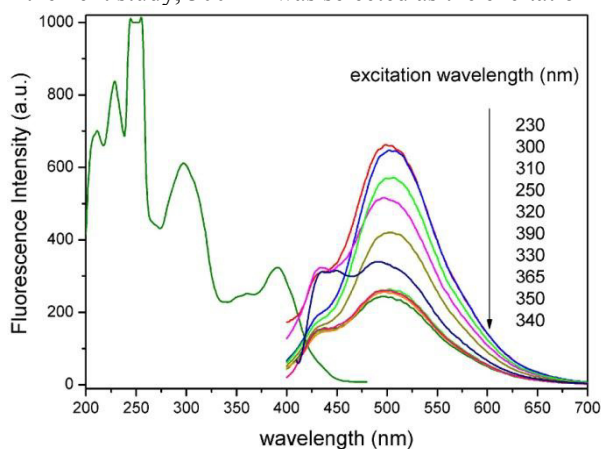


Fig. 1. The excitation and emission spectra of DPDTC solution in 1:1 EtOH/H₂O mixture.

Photostability of DPDTC was measured at 505 nm by consecutive excitation (one every 5 seconds) at 300 nm. As can be seen in Fig. 2, even after 300 successive illuminations, 93% of the initial fluorescence intensity remained and no difference in the emission shifts were observed, indicating that DPDTC is a stable fluorescent probe.

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