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An aqueous fluorescent sensor for Pb^{2+} based on phenothiazine-polyamide

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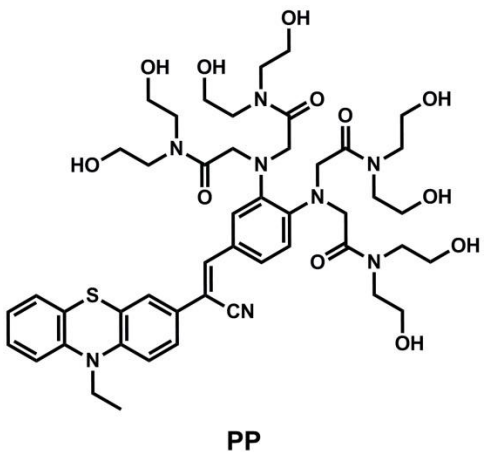
ABSTRACT

A sensitive and selective fluorescent sensor for Pb^{2+} ion based on phenothiazine-polyamide was built (named sensor **PP**). Due to introducing of four diethanolamine groups to polyamide, this sensor was totally water soluble. **PP** could detect Pb^{2+} ion within 1 min in the presence of other metal ions in aqueous solution, the detect limit was 9.11×10^{-8} M.

1. Introduction

Lead ion (Pb^{2+}) represents one of the most toxic heavy metal pollutions in environment, causing serious threat to human health. A limit of 10 μg/L Pb^{2+} in drinking water was recommended by World Health Organization (WHO).[1] Exposure to Pb^{2+} can result neurological, reproductive, cardiovascular disorders,[2-4] particularly for children (where lead poisoning threshold in blood is set at 5 μM or 1.0 mg/L).[5] So, detection of Pb^{2+} has been of strong interest to the sensor and instrumentation community, through it still remains a challenging task regarding detection sensitivity, selectivity, response time, cost effectiveness and other relevant technical issues. Conventional instrumentation methods for detecting Pb^{2+} include atomic absorption spectrometry,[6] spectrophotometry,[7] anodic stripping voltammetry[8], inductively coupled plasma emission spectrometry,[9] and others. It is no doubt that these techniques provide sensitive and accurate measurements for Pb^{2+}. However, these instruments are usually expensive, unportable, and the operation is often complicated and time consuming, thus limiting the use in real-time, onsite detection or monitoring of Pb^{2+}. Chemical sensors, particularly those based on fluorescence molecules,[10,11] have been proven to be an effective alternative approach to detection of Pb^{2+} with great potential to be developed into small, portable, low cost and easy to use device in comparison to the conventional bench-top instruments. Various fluorescent sensors have been synthesized to detect Pb^{2+}.[12-20] However, some fluorescent detectors were water insoluble, which meant these molecules could not test Pb^{2+} in water.[21-25] For human and environment, Pb^{2+} mainly exists in aqueous media, so water soluble fluorescent molecules for Pb^{2+} are more practical.

In this paper, we synthesized a totally water soluble fluorescent molecule (named for **PP**，shown in Scheme 1) based on phenothiazine fluorophore and polyamide receptor,[26-29] with connecting four diethanolamine groups to polyamide receptor. Diethanolamine group could not only strengthen water solubility but also serve as receptor for Pb^{2+} ion. This **PP** molecule really responded to change of Pb^{2+} ion concentration in aqueous solution.



PP

Scheme 1. The molecular structure of sensor **PP**.