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A Simple Turn-On Schiff base Fluorescence Sensor for Aluminum Ion

Jinli Zhu ^a, Yuhuan Zhang^c, Lun Wang^b, Tongming Sun ^a, Miao Wang ^a, Yipu Wang ^a, Danyang Ma ^a, Qingqing Yang ^a and Yanfeng Tang ^{a,*}

a. School of Chemistry and Chemical Engineering, Nantong University, Nantong 226019, P.R. China

b. Inspection and Quarantine Center of Shandong Exit & Quarantine Bureau, Qingdao, 266001, P.R. China

c. School of Textiles, Nantong University, Nantong 226019, P.R. China

Abstract: A simple Schiff base **L** derived from 2-hydroxy-naphthalene-1-carbaldehyde and benzene-1,2-diamine, was proved to be a turn-on fluorescent probe for the recognition of Al³⁺, based on photoinduced electron transfer (PET) mechanism. It exhibited a high selectivity for Al³⁺ over other competing ions (e.g., Hg²⁺, Ag⁺, Pb²⁺, Cu²⁺, Ba²⁺, Cd²⁺, Zn²⁺, Ni²⁺, Co²⁺, Fe²⁺, Fe³⁺, Mn²⁺, Li⁺, Cr³⁺, Ca²⁺, Mg²⁺, K⁺, Na⁺) in EtOH/HEPES buffer (95:5, v/v, pH = 7.2). The complex formation of **L**-Al³⁺ was determined to be 1:1 for **L** and Al³⁺ in molar. This result was based on the Job plot, ¹H NMR titration and ESI-mass. The binding constant of the complex was 6.53 × 10³ M⁻¹ with a detection limit of 1.08 × 10⁻⁷ M. The potential applications of **L** to detect Al³⁺ in live cells and in environmental water samples were also investigated. The results indicated that **L** could be a promising probe for Al³⁺ recognition.

Keywords: Al³⁺ detection, PET, Schiff base, turn-on fluorescence, live cells

Introduction

Aluminum is the third most abundant metal in the earth's crust. It is extensively useful in many fields, from the national defense to our daily lives. These fields include aerospace industry, automobiles, computers, packing materials, electrical equipment, machinery, food additives, building construction, clinical drugs and water purification ^[1,2]. Aluminum also plays a great role in biochemical reactions, such as enzyme-catalyzed reactions ^[3], biotechnological transformation ^[4], and others. However, nowadays, a large amount of medical research reveals that excessive absorption of aluminum is harmful to human health. It sometimes leads to diseases, such as Alzheimer's disease ^[5-6], Parkinson's disease ^[7], osteoporosis ^[8] and osteomalacia ^[9]. Therefore, it is of great importance to develop the efficient methods for the detection of aluminum, especially in drinking water.

So far, several methods are available for the detection of aluminum, including atomic absorption spectrometry (AAS) ^[10], atomic emission spectrometry (AES) ^[11], voltammetry ^[12]

* Corresponding author

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