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Communication

Synthesis and application of highly sensitive fluorescent probe for Hg^{2+} regulated by sulfur

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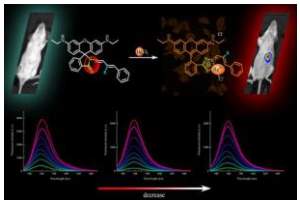
Graphical abstract



ABSTRACT:

Rhodamine-based fluorescent probe is widely used in chemical analysis, environmental analysis and life sciences area due to their excellent optical properties. Based on the thiophilic property of Hg^{2+}, using C=S structural motif as the core segment, our group have designed and synthesized three novel probes containing cinnamyl aldehyde with different substituents, exhibiting high selectivity and excellent sensitivity. The structure-property relationships of these probes have been investigated that the optical change caused by electron withdrawing effect and heavy atom effect. Furthermore, these Hg^{2+} probes could be applied in living mice imaging, which provide a promising tool for quantitative mercury (II) ion imaging in living organism.

Keywords:
Fluorescent probe
Rhodamine 6G
Mercury (II) ion
Electronic effect
Biological application

Introduction

The heavy and transition metals (HTMs) contamination has sparked interest in worldwide owing to their damage to environment and human health [1-7]. Among those HTMs, Hg^{2+} is one of the most dangerous and ubiquitous pollution in environment that the Environmental Protection Agency (EPA) standard for the maximum allowable level of inorganic Hg(II) in drinking water is 2 ppb, because biomethylation of Hg^{2+} to $MeHg^{+}$ occurs in ground-surface water bodies by various aquatic microorganisms (mainly sulfate-reducing bacteria) accumulated in the trophic chain [8-11]. Besides, Hg^{2+} could easily pass through biological membranes, skin and gastrointestinal tissues, and then accumulate in body leading to serious diseases of central nervous system, such as kidney failure, prenatal brain damage, cognitive and motion disorders, vision and hearing loss and even death [12-20].

Due to serious harm of Hg^{2+} to the environments and human health, it is quite necessary to develop a rapid and low-cost method for detection of Hg^{2+} with high sensitivity and selectivity. Traditional methods including atomic absorption/emission spectroscopy, high-performance liquid chromatography and inductively coupled plasma mass spectrometry remain limited by their expensive instrumentation and sophisticated sample preparation [21-25]. However, fluorescence detection with Hg^{2+}-responsive probes not only meet the urgent demand for facile, sensitive, selective and cost-effective detection techniques of Hg^{2+}, but also offer a promising approach for simple and rapid tracking of Hg^{2+} in biological, toxicological and environmental monitoring [26-32].