New chromo-fluorogenic probe containing a BODIPY unit for the detection of Hg(II) in water

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Detection and quantification of transition metal cations in environmental chemistry and clinical toxicology has been extensively explored, in the last years, due to its high polluting power [1,2]. The design and synthesis of chemosensors with high selectivity and sensitivity for heavy metal cations has received noticeable attention because they have caused serious risks for the environment and human health. Among them, mercury is one of the most toxic metal ions, even at slow concentrations. Accumulation of mercury over time in the human body can lead to many cognitive and motion disorders and Minamata disease [3-5].

We present here a new chomo-fluorogenic probe able to detect in water Hg(II) with the "naked-eye" in the visible wavelength region (see Figure 1). The probe is composed by a BODIPY fluorophore, as signaling subunit, because of its high quantum yields, high solubility in water and organic solvents. This BOPIPY fluorophore was electronically connected with a crown ether (containing nitrogen, oxygen and sulfur atoms) that presented a high Hg^{2+} affinity.

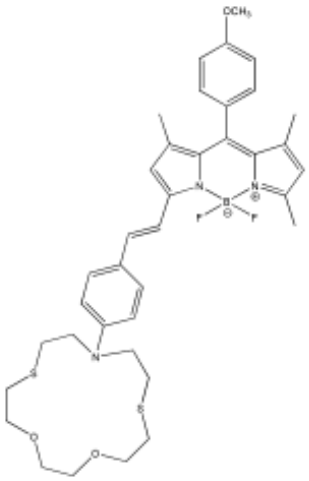

Figure 1

Solutions of receptor in water-acetonitrile 95:5 v/v at pH 7.0 present an absorption band centered at 614 nm, which gives an intense blue color. UV-visible and fluorescence spectra of probe were studied in the presence of 10 equivalents of several metal cations (Na^+, K^+, Li^+, Mg^{2+}, Ca^{2+}, Co^{2+}, Ba^{2+}, Cu^{2+}, Ni^{2+}, Zn^{2+}, Hg^{2+}, Al^{3+}, In^{3+}, Cr^{3+}, Ga^{3+}, Fe^{3+}, As^{3+}). Of all the tested cations only Hg^{2+} is able to change the color of the solution (from blue to pink clearly discernible by the naked eye) (See Figure 2).

Figure 2

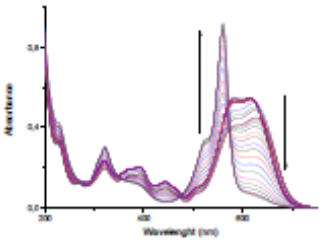

Figure 3

UV-visible spectra of probe **BP6** (5.0 x 10^{-5} $molL^{-1}$) in water-acetonitrile 95:5 v/v (pH 7.0) at increasing concentrations of Hg^{2+} (0-25 eq.)

These changes are reflected in the appearance of a new band in the visible region, centered at 561 nm. (See Figure 3). On the other hand, a significant increase in fluorescence upon addition of Hg(II) cation was also observed (See Figures 4 and 5).

Figure 4

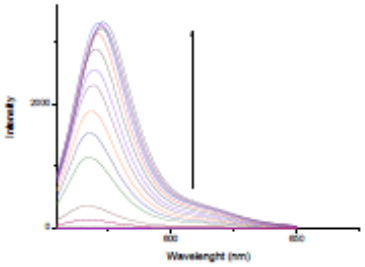

Figure 5

Fluorescence spectra of probe **BP6** (5.0 x 10^{-5} $molL^{-1}$) in water-acetonitrile 95:5 v/v (pH 7.0) at increasing

From the titration profiles, a limit of detection of 99 ppm of Hg^{2+} was measured. Besides, Job plot analysis indicated the formation of 1:1 stoichiometry probe-Hg^{2+} complex.

References:

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