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Selective Chemosensor Based on 7-Nitrobenzofurazan in Tripodal Structure for the Detection of Hg(II) Ions in Environmental and Cosmetic Samples

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A selective tripodal chemosensor based on 1,1,1-tris[(7-nitrobenzofurazan-4-yl)-n-1-aza-5-oxa-hexanyl] propane (**1**, TNFHP) has been developed for the detection of Hg(II) ions. This receptor exhibits a pronounced chromogenic behavior toward Hg(II) ions by changing the color of the solution from yellow to dark orange upon its addition, which can be easily detected with the naked-eye. Based on this sensing scheme, a colorimetric method was developed, where the absorbance linearly increases as a function of the Hg(II) ions concentration up to 5.0×10^{-5} M, with a detection limit of 0.1 μM. The colorimetric results of the detection of Hg(II) ions in environmental samples are in good agreement with those obtained by cold vapor atomic absorption spectrometry. This chemosensor has also been applied for detection of Hg(II) ions in cosmetics samples.

Keywords: Chemosensor, Tripodal Platform, Colorimetric Method, Hg(II), Environmental, Cosmetics.

RESEARCH ARTICLE

1. INTRODUCTION

Heavy metals are one of the most serious pollutants in our environment due to their toxicity, persistence, and subsequent bioaccumulation through the food chain. For instance, mercury is well known as the most prevalent toxic metal and has immunotoxic, genotoxic, and neurotoxic effects on the human health.[1–3] It has a wide distribution and is released via natural events or human activities. This is due to the fact that mercury can be spread through multiple pathways, i.e. water, air, food, etc.[4] The Environmental Protection Agency (US EPA) standard for the maximum allowable level of mercury in drinking water is 2 ppb[5] and its use is prohibited in cosmetics products.[6] Therefore, there is a high demand for the detection of mercury ions in the environment as well as in industrial waste and products, e.g. cosmetics. In order to address this issue, a possibility is to employ chemosensors, in particular molecular probes that generate and transduce an analytical signal as response to the binding event between the probe and the target analyte,[7–12] Currently, there are several examples of Hg(II) sensors that can selectively detect Hg(II) ions, particularly in aqueous medium as described in very recent reviews.[11–13] However, most of the reported chemosensors have some disadvantages, such as a complicated synthetic route,[14–16] cross-sensitivities towards other heavy metal ions,[17] limited and strict reaction conditions,[18,19] and low solubility in aqueous medium,[20–22] In this direction, the development of a simple chemosensor that can selectively detect Hg(II) ions in aqueous medium without pre-conditioning or sample pre-treatment is very challenging.

Tripodal structures as sensor platform[10] are attractive due to their excellent flexibility in capturing heavy metal ions as target analyte upon appropriate functionalization. This type of sensors has been used for the detection of Hg(II) ions in aqueous medium.[23,24] In order to further explore the favorable feature of the tripodal structure as sensor platform, we have developed a novel tripodal chemosensor that selectively binds Hg(II) ions. It concerns the use of a very flexible C_3-symmetric platform, which consists of a central carbon atom, substituted with three identical arms that can be functionalized with a suitable chelating

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