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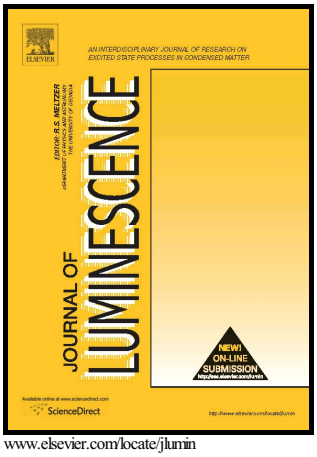

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A novel coumarin-based chemosensor for colorimetric detection of Ag(I) ion and fluorogenic sensing of Ce(III) ion

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ABSTRACT

A novel coumarin dye was synthesized, which acts as a chemosensor for selective detection of Ag^+ and Ce^{3+} ions in aqueous solution. Upon addition of Ag^+ to the sensor solution a new absorption band centered 580 nm was observed and the color of the solution changed from pale yellow to brown while other metal ions (Cu^{2+}, Hg^{2+}, Zn^{2+}, Li^+, Na^+, Al^{3+}, Fe^{3+}, Co^{2+}, Ni^{2+}, K^+ and Cr^{3+}) did not cause distinct change. The coumarin dye can also be used as a fluorescence turn-on chemosensor for selective detection of Ce^{3+} over other metal ions including common trivalent metal ions Al^{3+}, Fe^{3+} and Cr^{3+} as well as lanthanide metal ions Pr^{3+}, Yb^{3+}, Nd^{3+} and La^{3+}. Investigation on changes in the intensity of the fluorescence emission band at around 350 nm with the equivalent ratio of Ce^{3+}/sensor (0–1.1) reveals an approximate linear relationship, from which the concentration of Ce^{3+} ion may be estimated. The detection limit of Ce^{3+} ion by the sensor is estimated to be 2.07×10^{-7} M.

Keywords: Fluorescence; coumarin; sensor; colorimetric; silver(I); cerium(III)

1. Introduction

It is known that silver has been extensively used in electrical industry, photographic and imaging industry, and pharmacy. However, accumulation of Ag^+ ions affects multiple targets in living systems. Therefore convenient and selective sensing of Ag^+ ion is of high significance due to its potential toxicity but wide utility. Potentiometric probe [1], electrochemical biosensor [2,3] and interferometry [4] have been developed for detection of Ag^+ ion. But these methods rely mainly on sophisticated instruments and experienced operators. Colorimetric [5,6] and fluorescent chemosensors [7–20] are better choices for rapid and selective detection of Ag^+ ion. Some fluorescent probes can be utilized for simultaneous detection of Ag^+ ion and other ions such as Hg^{2+} ion [21–23], Cu^{2+} ion [24], protons [25], Cu^{2+} and Fe^{3+} ions [26], Ni^{2+} and Pd^{2+} ions [27], and CN^- ion [28]. On the other hand, as the most abundant element of the lanthanide group, cerium has wide industrial applications in the fields like lighting and television,