Selective naked-eye detection of Magnesium (II) ions using a coumarin-derived fluorescent probe

1. Objective of work

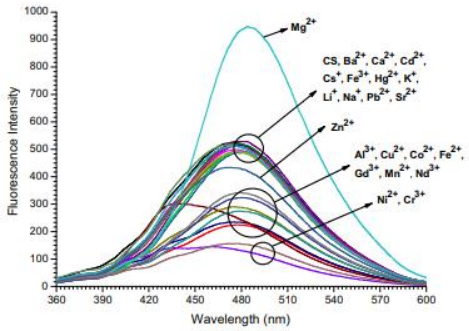
The detection and quantification of Mn^2+ is relevant for accurate diagnosis. However, actual fluorescent probes are not selective with other ions. In this work, 4-Methyl-7-hydroxy-8-formyl Coumarin (CS) as chemosensor for Mn^2+ in presence of other metal ions.

2. Sample description

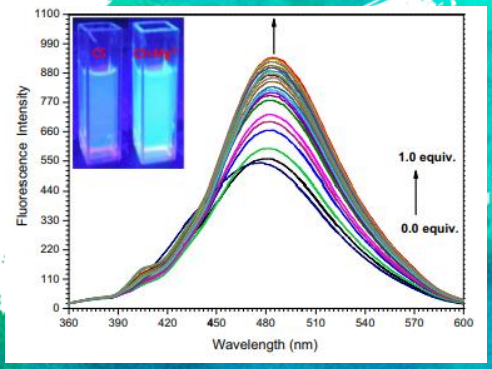
The synthesis of CS is presented by the next steps: First, a solution of resorcinol (20 mmol) in ethyl acetoacetate (30 mmol) is added to sulphuric acid (20 mL) at 0-5 °C. The obtained solid was filtered and recrystallized from methanol. Then, the obtained mixture (10 mmol) is combined with hexamethylene tetramine (30 mmol) in glacial acetic acid (20 mL) while were refluxed for 4-5 h in water bath. Finally, 20% HCl (25 mL) was added and heated for 30 min, cooled to room temperature and extracted with diethyl ether.

3. Equipment and conditions for fluorescence

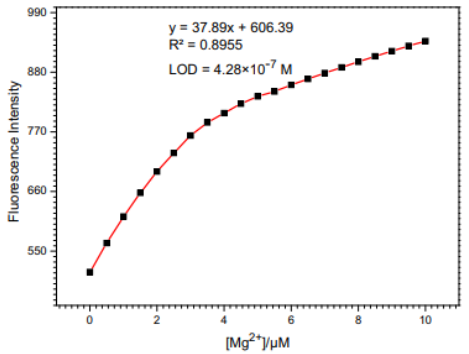
the Fluorescent spectra were recorded by using Shimadzu RF-5301PC spectrofluorophotometer (Japan). The measurements were carried out in 1 cm path length quartz cuvettes in alcoholic medium (MeOH) at room temperature. The concentration of various metal ions were 10 µM, including Mn^2+. The excitation wavelength was 350 nm with both the excitation and emission slit widths were 3 and 5 nm, respectively.



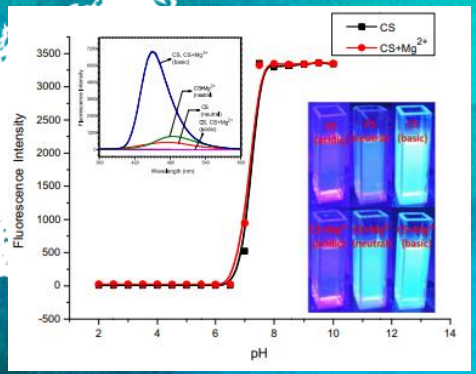
Fluorescence spectra of receptor CS in presence of various metal ions.



Fluorescence spectra of receptor CS with Mn^2+ on different concentrations.



Linear relation of fluorescence intensity toward Mn^2+ concentration.



Fluorescence intensities of CS-Mn^2+ under different pH conditions.

4. Results

The chemosensor showed a single emission band at 473 nm with chelation enhanced fluorescence (CHEF) only with Mn^2+ even if other metal ions showed fluorescence effect. As well, an increasing emission can be visualized by the addition of Mn^2+ from 0 to 1 equiv. It has been found that the limit of detection (LOD) for Mn^2+ is 4.28x10^-7 M. A change of pH can modified the CS response. In a basic medium, the fluorescence emission was observed at 448 nm in a high intensity. However, in acidic conditions the fluorescence intensity decreases at 485 nm.