ABSTRACT

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Title of the thesis: ***"Design and Synthesis of Rhodamine-6G Based Highly Selective Fluorescent Probes for The Metal Ion Sensing"***

In the present thesis some significant rhodamine-6G based fluorescent molecular probes are documented which are all highly selective, very much sensitive and bio-compatible for the recognition of cations in pure and mixed aqueous medium. The major emphasis has been given on their synthesis, characterisation and photophysical studies and biological applications of these probes.

Chapter-1 focuses on brief introduction on chemosensing methods and its applications for the detection of biologically important and toxic metal ions. This chapter explains how to design a molecular probe and different mechanistic pathways for chemosensing. This chapter also describes brief literature survey on rhodamine-6G based probes for the detection of Cr^{3+}, Al^{3+}, Fe^{3+}, Hg^{2+}, Cu^{2+}, Ca^{2+}, Pb^{2+}, Pd^{2+}, Au^{3+} and Cd^{2+}. A very brief overview of the present work is highlighted here.

Chapter-2 represents synthesis, characterisation, single-crystal X-ray crystallographic study and photophysical processes of a rhodamine-6G based chemosensor, $\mathbf{L^1}$. It exhibits large enhancement of fluorescence intensity of $\mathbf{L^1}$ at 558 nm by Fe^{3+} (41-fold), Al^{3+} (31-fold) and Cr^{3+} (26-fold) in H_2O/CH_3CN (4: 1, v/v, pH 7.2). The corresponding K_f -values are reported as 9.4×10^3 M^{-1} (Fe^{3+}), 1.34×10^4 M^{-1} (Al^{3+}) and 8.7×10^3 M^{-1} (Cr^{3+}). LODs for Fe^{3+}, Al^{3+} and Cr^{3+} are reported as 1.28, 1.34 and 2.28μM respectively. Construction of advanced level molecular logic gate and memory devices using 2 and 4 inputs are given. This probe is found to be suitable for bio-imaging applications in living cells.

Chapter-3 focuses on the synthesis and characterisation of rhodamine-6G based chemosensor, L^2 by spectroscopic studies and photophysical studies. Probe showed huge enhancement of fluorescence intensity in the presence of Hg^{2+} (126 fold), fair sensitivity (47nM for Hg^{2+}), good formation constant $K_f = (1.01 \pm 0.01) \times 10^4$ M^{-1} with binding ratio (1: 1), pH compatibility and cell imaging studies are reported and explained here. Fluorescence intensity of Hg^{2+} complex reaches maximum at 7 mM of SDS on further increase in SDS concentration fluorescence intensity decreases gradually demonstrating AIEE behaviour.

Chapter-4 describes synthesis, characterisation and photophysical studies of a new rhodamine 6G-based chemosensor, $\mathbf{L^3}$. This probe exhibits an excellent selectivity and sensitivity for the recognition of trivalent metal ions M^{3+} (M = Fe, Al and Cr) with prominent enhancement in fluorescence intensity: Fe^{3+} (669-fold), Al^{3+} (653-fold) and Cr^{3+} (667-fold) in H_2O/CH_3CN (7:3, v/v, pH 7.2). The K_d values for (1:1) metal-probe complexes and LOD's are evaluated and presented here. Construction of advanced level molecular logic gate and memory devices also discussed here.

Chapter-5 deals with synthesis, characterisation and photophysical studies of a novel rhodamine-6G based chemosensor, $\mathbf{L^4}$**.** It exhibits an excellent selectivity and sensitivity for the detection of Fe^{3+} in pure aqueous medium. The K_f value is evaluated as $(1.16 \pm 0.04) \times 10^4$ M^{-1} for 1:1 binding. LOD of Fe^{3+} by $\mathbf{L^4}$ is determined to be 4.184 μM. This chemosensor beautifully mimics INHIBIT logic gate which helps to construct a memory device.

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