INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

In the field of ion and molecule sensing, quantum dots and their modified forms have demonstrated their utility with many advantages. Among different types of optical sensors, ratiometric sensors have more advantages like self-calibration, visual color change, and independence of intensity fluctuation. Due to these properties, the ratiometric sensors are comparatively more reliable and efficient. Quantum dot complex (QDC) – that is made up of inorganic complex functionalized on the surface of a quantum dot - is a perfect nano-system that can be utilized as a ratiometric sensor due to its multiple independent emissions, high thermal, and photostability, high quantum yield, etc. The present thesis focuses on the fabrication of different QDC-based ratiometric optical nanoprobes for (i) toxic and heavy metal ion (like Hg^{2+} and Cu^{2+}) sensing, (ii) phosphate ion sensing, and (iii) selective recognition and sensing of long-chain unsaturated fatty acids (LCUFAs). The present thesis is divided into five chapters. A brief discussion of each chapter is given below. Chapter 1 describes the literature survey of quantum dots, their surface modification technics, and sensing applications. Chapter 2 presents a ratiometric optical nanoprobe for Hg^{2+} and Cu^{2+} sensing. A dual emitting QDC formed by N-methyl salicylaldimine (MSA) and Mn^{2+}-doped ZnS Qdots has been used to fabricate the sensor, which changed its color from purple to blue to detect Hg^{2+} and Cu^{2+} with a limit of detection (LOD) of 85.5 nM for Hg^{2+} and 34.9 nM for Cu^{2+}. Chapter 3 demonstrates a QDC-based ratiometric phosphate sensor consisting of $Zn(QS)_2$ (QS = 8-hydroxyquinoline-5-sulfonate) complex on the surface of Mn^{2+}-doped ZnS Qdots. The change in color of the QDC from white to orange helped to detect phosphate ions with a detection limit of 5.9 nM. Quantitative measurement of phosphate concentration in environmental water and commercial fertilizer was also made possible using the presented nanoprobe. Chapter 4 presents a QDC-based nanoprobe for selective recognition and ratiometric sensing of long-chain unsaturated fatty acids (LCUFAs). The nanoprobe has been designed by the formation of ZnQ_2 complex (Q

= 8-hydroxyquinoline) on the surface of Mn^{2+}-doped ZnS Qdots. A color change from white to cyan was observed during the detection of LCUFAs. The LOD was calculated for three different LCUFAs and found to be 0.127 μM for oleic acid, 0.126 μM for linoleic acid, and 0.103 μM for erucic acid. The nanoprobe successfully detected LCUFAs in commercial vegetable oils with high accuracy. Chapter 5 contains an overview and future prospects of the present thesis.