INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study : Ph.D.

Thesis Title: **Photo-luminescence Guided Metal Ion Sensing and Environmental Remediation Applications of Green Synthesized Iron and Iron-based Nanomaterials**

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SHORT ABSTRACT

This work addresses the state of the art, research motivation towards the green synthesis approach. The study involves a vivid analysis of selecting suitable green sources among different spices (clove, cardamom, bay-leaf; common name) based on its total phenolic content (TPC), flavonoid content (TFC), tannin content (TTC), and antioxidant property. The selected green source (clove) mediated iron nanoparticles were then utilized for degradation of crystal violet dye, and its efficiency was compared with the other green source mediated iron nanoparticles. Moreover, the work analyzes better solvents for extraction of polyphenols, flavonoids, tannins, and their antioxidant property from clove as a green source. Moreover, optimization of maximum phenolic and flavonoid content of the clove extract was carried out by controlling parameters such as time of extraction, extraction temperature, and volume of extraction solvent. The study presents the morphological and chemical property dependency of synthesized Fe NPs with pH. Moreover, it investigates the photoluminescence behavior of synthesized Fe NPs towards the heavy metal ion sensing ability. The Fe NPs were found to act as a better Fe^{3+} ion detector within a linear range of micromolar concentration, in presence of other heavy metal ions. Further, it describes the preparation of the clove extract mediated ZVI NPs embedded pH-responsive polymeric membrane for reducing nitrobenzene to aniline present in wastewater. The nitrobenzene reduction process was maximized by optimizing the controlling parameters such as time, medium pH, iron NPs content. Furthermore, the membrane was also utilized for studying the fluoride rejection behavior. The work focuses on the effectivity of clove extract in preparing iron-aluminum bimetallic nanocomposite and its application towards removing fluoride and enhancing the overall quality of real-life water collected from Northeast regions of India. Finally, it describes the dual activity of such green synthesized iron-aluminum nanocomposite by investigating its heavy metal sensing ability in the real-life water sample. In presence of various heavy metals, the nanocomposite was found to be effective in detecting Fe^{3+} ion and showed a linear range of applicability for real-life water collected from college campus IIT Guwahati, India.