INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: **Metal Ion Based Assemblies of Gold Nanoclusters with Tuneable Photoluminescence**

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Thesis Submitted to the Department/ Center	:	**Chemistry**
Date of completion of Thesis Viva-Voce Exam	:	**01.12.2023**
Key words for description of Thesis Work	:	**gold, nanoclusters, assembly, luminescence**

SHORT ABSTRACT

The dissertation focuses on developing metal ion-mediated crystalline assembly of gold NCs through chemical reactions to develop functional nanomaterials with tailored properties. Through the envision of inorganic complexation reaction, the assembly of ligand-stabilized gold NCs is possible with metal ions, which supersedes the constituent clusters in terms of tailorable structural properties and hold potential in the advancement of the field. Also, facile development of higher dimension cluster assembly with intriguing optical and physio-chemical properties along with well-defined geometries is achievable. In this context, the effects of transition metal ions and lanthanide metal ions for assembling NCs were investigated for such formation of crystalline nanostructures, which could induce the possibility of amplification in multifunctional properties. The present thesis is divided into five chapters. Details of works incorporated are briefly discussed here.

Chapter 1 covers an overview of metal NCs including their syntheses, characteristics, and their structural assembly. Also, the key applications in various fields are discussed.

Chapter 2 describes the formation of a two-dimensional (2D) multi-layered crystalline assembly of gold NCs via the coordination of zinc metal ions and the terminal groups of ligands stabilizing the clusters achieved at room temperature. Finally, the photoluminescent 2D layered nanosheets of zinc gold NCs were efficient to store molecular oxygen at ambient conditions.

Chapter 3 demonstrates the delayed fluorescence enhancement of europium ion with prolonged lifetime through interactions of ligand stabilized gold NCs. The different Eu-centric emissions following complexation with NCs had selective augmentation in spectral lines

attributed to the modulation of the $^5D_0 \rightarrow {}^7F_j$ transitions. Further, the photoluminescent properties - that included delayed Eu emission - from each component could be modulated through functionalization of phosphate ions. Such way, possibility for developing an optical system by conjugating molecular NCs and atomic luminescent probes into superior nanomaterials has potential usage in various fields.

Chapter 4 presents the generation of synchronous tri colour (orange, green and blue) emission from a single excitation wavelength out of inorganic surface complexation reaction on gadolinium based 2D single crystalline assembly of gold NCs. Further, the assembled crystalline superstructure with augmented lifetime and quantum yield, emitted white light with colour chromaticity coordinate of (0.34,0.33) in the dispersed phase and colour rendering index (CRI) value >85 which would offer innovative entrants in the field of LEDs.

Chapter 5 comprises the summary and future prospects of the present thesis work.