INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study	:	Ph.D.

Thesis Title: Study of Doping & Functionalization of Graphene Quantum Dots for Sensing and Optoelectronic Applications

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Thesis Submitted to the Department/ ~~Center~~	:	Physics
Date of completion of Thesis Viva-Voce Exam	:	04/01/2020
Key words for description of Thesis Work	:	Graphene quantum dots, optical sensing, optoelectronic applications.

SHORT ABSTRACT

The present thesis focuses on the optical sensing and optoelectronic applications of various types of doped graphene quantum dots (GQDs) and their heterostructure with plasmonic nanoparticles (Au NPs) and other semiconductors (e.g., single walled carbon nanotubes (SWCNTs), WS_2 QDs). The complete thesis work is presented in seven chapters. Chapter 1 presents a brief overview of the important properties, different synthesis techniques, promising applications of various types of graphene quantum dots, and the motivation behind the present thesis. Chapter 2 discusses on the mechanism of anomalous photoluminescence (PL) quenching of undoped GQDs through the functionalization with SWCNTs. Chapter 3 elucidates the origin of high PL quantum yield in nitrogen doped GQDs (N-GQDs) and their applications as SESR sensor and white light convertor. It is shown that doping states and e-donating groups are primarily responsible for the high PL quantum yield in N-GQDs. We isolate the individual contribution of Förster resonance energy transfer (FRET) and $\pi-\pi$ interaction to the observed high SERS sensitivity. In chapter 4, graphene oxide is used to make hybrid with tungsten disulfide quantum dots to detect dopamine in pM level by photo-excited charge transfer process. Chapter 5 presents N-GQDs decorated Au nanoparticles (Au@N-GQDs) for the sensing of dopamine through unique core-shell structure formation. In chapter 6, Au@N-GQDs are further implemented for the detection of Fe^{3+} in real life samples by exploiting the non-linear quenching, which is modeled by considering the charge transfer dynamics and Langmuir's law of adsorption. Chapter 7 presents a summary of the significant findings and important conclusions of the present thesis and the future scope of work.