INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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The present thesis focuses on the synthesis of large lateral-size graphene oxide (GO) and its derivative materials, such as reduced graphene oxide (RGO) and graphene quantum dots (GQDs); further, synthesized materials use various sensing applications. Large lateral-size GO is exfoliated from graphite oxide using a newly proposed technique, mild heating technique. GO sheets are exfoliated up to 106 µm, which is 15 times larger than the general exfoliation technique (ultrasonication). Furthermore, the large lateral size of RGO is synthesized using chemical and thermal treatment by pre-drop cast before reduction treatment. Moreover, Ultra-small GQDs (1.53 nm) are synthesized using the hydrothermal method assisted with the Tip sonication technique. The properties of the GO and its derivative materials are confirmed from the analysis of the XRD, Raman, FESEM, FETEM, XPS, FTIR, PL, and UV absorbance. Structural properties of the GO, RGO, and GQDs are modified using a simple, efficient, and low-cost process, gas plasma treatment. Argon plasma treatment on the GO (Ar-GO) generated structural defects without losing many functional groups, confirmed by the Raman and XPS analysis. The materials are analyzed for the SERS effect of various dyes, such as methyl blue (MB), methyl orange (MO), rhodamine B (RhB), and rose Bengal (RB). RhB has a higher enhancement factor (EF) due to the easy charge transfer between the material and RhB. Further, Ar-GO has improved the EF of RhB by providing more interaction sites for the analyte molecules. GO-based photodetector and CO_2 sensor device are made on the 10 µm channel inter-digitated electrode (IDE). Similarly, Ar-GO has exhibited high photo-response compared to the GO and nanohybrid of SnO_2 NPs (SO) and GO, possibly due to the increased charge trapping site on the Ar-GO. The electrical conductivity of GO is increased as the annealed temperature increases, which is due to the restoration of sp^2 hybridized graphitic structures after the removal of oxygen functional groups. The CO_2 sensitivity is 19% for the nanocomposite of the GQDs and SO due to the increased charge transfer to the analyte molecules.