ABSTRACT

Recent studies have been focused on the investigation of nanostructured materials based on their unique properties for their applications in the field of fluorescence sensing In this regard, fluorescent carbon dots (CDs) and CDs hydrogel have been explored possessing unique characteristics, such as biocompatibility, low toxicity, water solubility, generation of variety of surface functionalities, electrical conductivity, and high quantum yield. However, fabrication of highly fluorescent CD hydrogel without any gelling agent is a challenging. In addition to no reports are available highlighting optical interactions between fluorescent CDs and graphitic materials (GMs) and photo-physical features of this system. In view of this, synthesis of low-cost carbon dot weak gel (CDWG) in the absence of any gelling agent from a pear juice. The CDWG and water-dispersed ACDs (WACDs) exhibited multicolor and blue-green fluorescence emission due to changes in the polarity of the medium from ACDs. Our studies showed QY of ACDs (3.82 %) was found to be higher than other foods derived and bioprecursors. Such fluorescence property of green synthesized CDs (both CDWG and WACDs) also successfully demonstrated quenching in presence of 2D GMs (graphene oxide: GO and reduced graphene oxide: RGO). The quantitative quenching efficiency, i.e. limit of detection (and limit of quantification) are found to be 1.5 (5) in CWDG and 1.08 (3.61) in WACDs for G and for GO is 1 (3.33) in CDWG and 1.94 (6.45) μg ml^{-1} in WACDs in the range of 1.5-15.0 μg ml^{-1} respectively. These findings indicated their possible applications in in the sensing of metal ions, biomolecules, and in the fabrication of optoelectronics and photovoltaic devices.

The extensive uses of several electronic devices/technologies today generate electromagnetic (EM) wave radiation. This results in the EM interference (EMI) of EM waves causing their malfunctioning, degradation and performance in addition to the adverse effect on human health. Therefore, development of low cost, easily processable, light weight, and high EMI shieling materials comprising conducting metal/carbonaceous, dielectric materials, and their composites have been receiving considerable attention following absorption and reflection of EM radiation. In view of this, the present thesis has been focused on fabrication of 3D hierarchical δ-MnO_2 nanoflowers, silver quantum dots (Ag QDs) and their RGO nanocomposites in one step following *in situ* reduction of their precursors by nonhazardous Fehling B solution and characterized. The DC conductivity of δ-MnO_2/RGO-1.0 nanocomposite was observed ~1.18×10^{-3} S cm^{-1} with a loading of 5.5 wt% RGO and exhibited EMI SE performance 26-39-33 dB of compared to δ-MnO_2 and its other nanocomposites in the frequency range of 2-8 GHz following reflection dominant shielding. In another work, conducting Ag/RGO nanocomposites showed excellent absorption (reflection loss ~ −79 to −82.5 dB) and EMI SE 39.2-43.8-42.3 dB in the range of 2-8 GHz due to proper impedance matching. In addition, CDs mediated fabrication of MnO_2/CD nanocomposites through *in situ* by co-participation. Our study showed that CDs is playing a crucial role to control the morphology of nanocomposite as well as reducing the aqueous potassium permanganate ($KMnO_4$). Further, the synthesized MnO_2/CD composite exhibited superior reflection dominant EMI SE 32.5-39.4 dB (2-5 GHz), 39.4 dB (5-6.5 GHz), and 39.4-35 dB (6.5‑8 GHz) due to impedance mismatch.

In summary, the present thesis provides simple and effective ways for the development of low-cost and promising nanostructured based materials for their superior performance in sensing and EMI shielding, and microwave absorption.

Keywords: Room temperature synthesis, Carbonaceous materials, Carbon dots hydrogel, Dielectric metal oxide, Metal, Nanocomposites, Sensing, EMI shielding, Microwave absorption.