**Abstract**

In recent years, the trimetallic nanoparticles (NPs) are of having great interest because of their novel properties and applications. Trimetallic nanoparticles have improved physicochemical properties compared to their monometallic nanoparticles. Among the other metallic NPs, trimetallic NPs possess scientific and industrial importance because of their unique properties namely, magnetic, optical, electronic, and catalytic for practical applications [1]. In the present paper, the attempt has been made to synthesize trimetallic Au-Ag/Ni nanocomposites on β-cyclodextrin functionalized reduced nano graphene sheets (β-CD-NGS) as the platform.

Graphene, a two-dimensional structure consists of sp2 hybridized carbon closely packed honeycomb lattices. It is considered as a basic building block for graphitic materials with all other dimensionalities [2]. It has considerable heed on both the experimental and theoretical fields because of its unique nanostructure and a variety of attracting thermal, mechanical, electrical properties. Based on these remarkable properties of graphene, these graphene nanosheets can be used as an ideal building block for nanocomposites and are broadly applied in many technological fields such as nanophotonics, sensors, catalysis, and supercapacitors [3]. But during the reduction process of graphene oxide (GO) to nano graphene sheets (NGS), NGS tends to agglomerates via Vander Waals interactions, due to the loss of oxygen containing functional groups in GO, and it is difficult for many potential applications. To overcome this problem, the β-Cyclodextrin (β-CD) is introduced into the graphene oxide before the reduction process is fully completed. The introduced β -CD onto the surface of NGS prevents the agglomeration of the NGS and improves the solubility of the β-CD-NGs in water [3]. This new composite have individual properties of two materials, such as large surface area and high conductivity of GO and supramolecular recognition and enrichment capability of β-CD. It is a macrocyclic allied oligosaccharides composed of seven glucose units. It is toroidal in shape with a hydrophobic inner cavity and a hydrophilic exterior which provides water solubility. The characteristic of β-CD facilitates them to selectively bind various organic, inorganic, and biological guest molecules into their cavities to form stable host guest inclusion complexes and also exhibits high molecular selectivity and enantioselectivity. Therefore, β-CD functionalized NGS are used as a platform for the preparation of nanocomposites [4]. In recent years metal nanoparticles (Au, Ag) have been used for many potential applications, because of their high surface to volume ratio and good catalytic activity compared to their respective bulk metals. The noble metals (Au, Pd, Pt etc.) doped with non-noble metals (Fe, Co, Ni etc.) is an admirable approach to intensify the catalytic activity and the sensitivity of nanomaterials [5]. The synthesized nanocomposites are characterized using UV-Vis, FT-IR, XRD, EDX and SEM analysis. Synthesized Pure NGS, β-CD, β-CD-NGS and β-CD-NGS-(Au-Ag/Ni) nanocomposites are characterized using UV-Vis spectroscopy. According to the UV-Vis spectral analysis, the absorption band for pure NGS are obtained around 240 nm and 300 nm for π-π\* transition of the atomic C-C bonds and n-π\* transitions of aromatic C-C bonds respectively and for β –CD the major peak observed around 260 nm. In the β-CD-NGS spectra, an absorption peak at 260 nm is observed, indicating the successful synthesis of β-CD-NGS. The UV-Vis spectra of β-CD-NGS-(Au-Ag/Ni) nanocomposite confirm the presence of all formed composites [3]. FT-IR spectra of pure NGS, β-CD, β-CD-NGS and β-CD-NGS-(Au-Ag/Ni) nanocomposites are recorded. From the results, the transmission bands of pure NGS obtained around 1100 cm-1, 1600 cm-1 and 3400 cm-1 may correspond to the bending vibrations of coupled C–C/C–O, O–H and O–H stretching vibration respectively. The FT-IR spectra of β-CD-NGS exhibits spectra for β-CD around 940 cm-1, 700 cm-1 and 570 cm-1 may due to the skeletal vibration and pyranose ring vibrations respectively, which is in good agreement with the pure β-CD spectrum. The main absorption peaks of pure NGS are also observed and it confirms the presence of β-CD molecules on the surface of GNS. The FT-IR spectra of β-CD-NGS-(Au-Ag/Ni) nanocomposites also confirm the presence of all the functional groups of synthesized nanocomposites [6]. The crystalline nature of the synthesized nanocomposites is studied using XRD analysis. By observing the sharp crystalline XRD peaks, the formation of pure nanoparticles without any impurities are confirmed .The microstructure of the Pure NGS, β-CD, β-CD-NGS and β-CD-NGS-(Au-Ag/Ni) nanocomposites are investigated by SEM analysis. In the SEM image of β-CD-NGS-(Au-Ag/Ni) nanocomposites, the bright spots are observed, which confirms the formation of trimetallic nanoparticles on CD-NGS [4]. The EDX spectrum of the prepared β-CD-NGS-(Au-Ag/Ni) nanocomposites confirms the presence of the β-CD, NGS, Au, Ag, Ni element in the prepared nanocomposites [7]. The as-synthesized nanocomposites may have many potential applications in removal of dye pollutants and waste water treatment technologies etc.