CUO-GRAPHENE / CU-GO NANOCOMPOSITES AS A POTENTIAL CATALYST FOR FUEL CELL APPLICATIONS

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Key Words:

Nanocomposites, Fuel Cells, Graphene, Metal oxides, Graphene Oxide

Introduction:

Recently, Fuel cells are gaining immense research attention due to their remarkable applications as the environmental friendly energy materials. Fuel cells convert chemical energy of fuels into electricity; they exhibit high efficiency when compared to the combustion engine. Although these fuel cells are clean and sustainable, highest efficiency of these fuel cells is in the range of 50-70% compared to the conventional combustion engine. Fuel cells comprise an electrolyte layer being sandwiched between the two electrodes.

To attain maximum efficiency, researchers are working on the development of new kind of materials as well as nanocompsites. Recently, Graphene and Graphene oxide doped metal and metal oxide nanocomposites have emerged as a suitable fuel cell materials exhibiting high efficiency. Particularly, metal oxide doped Graphene has received the research interest.

In this work, we propose to study the effect of metal doped into the Graphene oxide and metal oxide doped into Graphene and to compare their properties and application as fuel cells.

Objectives:

1. Stability is one of the main issues hampering the real commercialization of fuel cells with graphene-based materials.
2. Cost is another factor that influences manufacturing graphene-based materials for real fuel cell systems.
3. We propose, stable and cost effective synthesis of nanocomposites for their applications in fuel cell.
4. Green Synthesis of Copper oxide and copper nanoparticles and their characterization
5. Chemical Synthesis of Graphene and Graphene oxide and their characterization
6. Synthesis of CuO-Graphene and Copper-Graphene oxide nanocomposites and their characterization
7. Application of synthesized nanocomposites for fuel cells
8. Electrochemical studies of synthesized nanoparticles

Methodology:

a) **Biogeneic Synthesis of CuO nanoparticles**

4.82g of CuNO3.3H2O (0.2M) (100Ml) and 100 mL rudanti plant extract were mixed in a 500 mL three-necked flask. The reaction mixture was stirred at 80 °C for 4h. After being cooled to room temperature the CuO nanoparticles were collected by centrifugation and calcinated at 600◦C for 4hr.

b) **Synthesis of CuO/graphene.**

The CuO/graphene composite and CuO nanoparticles were prepared by a simple liquid method. In a typical synthesis, 0.01 mol Cu(CH3COO)2.5H2O was dissolved in 50 mL of deionized water with violent magnetic stirring, then 80 mg of graphene dispersed in 20 mL of ethanol (95%) was added to the above solution. Ammonia solution (10 mL, 25 wt%) was added to the resulting suspension last. After being stirred for 1 h, the resulting mixture was refluxed for 3 h. Vigorous stirring was maintained throughout the entire process. After the reaction, the solution was cooled to room temperature. The product was separated by centrifugation, washed with deionized water and absolute alcohol three times, and then dried in a vacuum oven at 90◦C for 24 h.

c) **Synthesis of Cu/GO composites**

In a typical synthesis process, GO (30 mg), CuCl2 (18 mg) and DI water (200 mL) were mixed in a 500 mL three-necked flask, the mixture was ultrasonicated at low energy for 1 h. NaBH4 (10 mL, 1%) was then added slowly, and the reaction mixture was stirred at 100 ◦C for 24 h. After being cooled to 50 C, the resulting hybrids were collected by centrifugation and were dried at 100 C under vacuum to give Cu/GO composites.

Figure: Nanocomposites prepared left (Cu/GO) right CuO/G

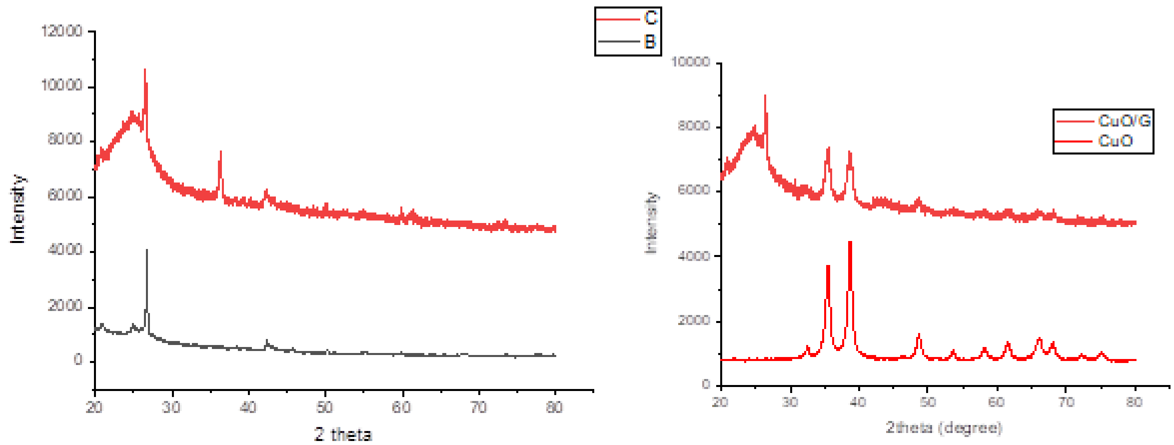

Figure 2. Powder XRD analysis of Cu/G (left) and CuO/G.

Result and discussion:

The chemical structures of Cu/GO composites were also characterized using a power XRD pattern. For the sample, the XRD pattern was illustrated in Fig. 3. It is found that GO are crystalline and the XRD pattern has peaks at 2theta = 26.2◦, which correspond to GO. After being coated with Cu nanoparticles the new peaks are attributed to Cu nanoparticles appear. These new diffraction peaks are located at 2 theta = 44.3◦, 64.4◦, and 77.4◦. These results indicate that Cu nanoparticles have been combined with GO.

The purities of the as-prepared CuO and CuO/graphene were confirmed by X-ray diffraction (XRD) spectrometry. As shown in Fig. all the peaks in spectrum can be assigned to CuO and graphene, 2theta = 26.49◦, which correspond Graphene. After being coated with CuO nanoparticles the new peaks that are attributed to CuO nanoparticles appear. These new diffraction peaks are located at 2 theta = 35.35◦, 38.59◦, 44.3◦, 48.47◦, 61.45◦, 64.4◦ and 74.4◦. These results indicate that CuO nanoparticles have been combined with Graphene.