Graphene-supported Platinum Catalysts for Fuel Cells Applications

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Fuel cells have become one of the major concerns in solving challenges associated with energy conversion. Attention has been directed to potential nanostructured catalysts, in order to improve the catalytic performances of electrodes developed for polymer electrolyte membrane fuel cells - an environmentally and feasible energy source [1-2]. Graphene could be used as a promising support material for Pt catalysts [3-4]. The results so far of an ongoing national project, which is intended to implement graphene-based electrodes for the PEM fuel cells manufacturing line from NCHFC Ramnicu Valcea-Romania are presented.

Samples characterization including electrochemical, microscopic and spectroscopic techniques is summarized as comparison with the latest technological advances in this field. Electrochemical proprieties and surface morphology of the electrodes were characterized using BET method, chemosorption technique, FTIR, cyclic voltammetry, ac-impedance spectroscopy, electrochemical polarization technique, X-ray diffraction, and microscopic techniques. With current study, the future perspective appears in a form of Pt-nanocomposite catalysts for fuel cells for long-term development.

Morphology and size information of the Pt/graphene nanocomposite depicted in figure 1 shows the non-spherical shape of the Pt nanoparticles supported by a graphene thin layer. The films are folded or continuous and it is possible to distinguish the edges of individual sheets, including kinked and wrinkled areas. Also it is noticed that a large number of particles are present with an average size estimated from XRD data (figure 2).

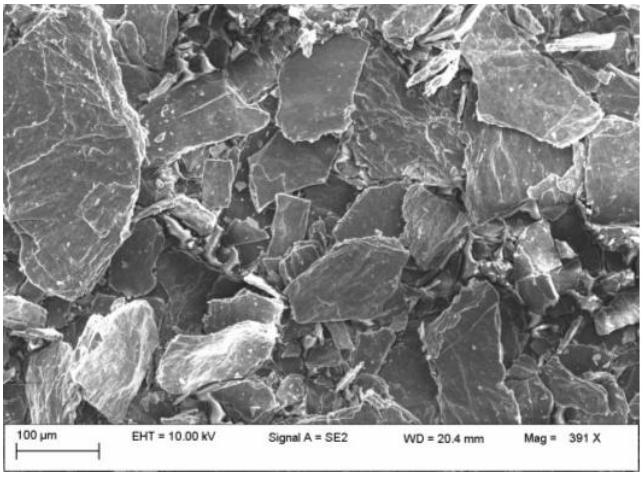

Figure 1: The SEM analysis of the Pt/graphene nanocomposite

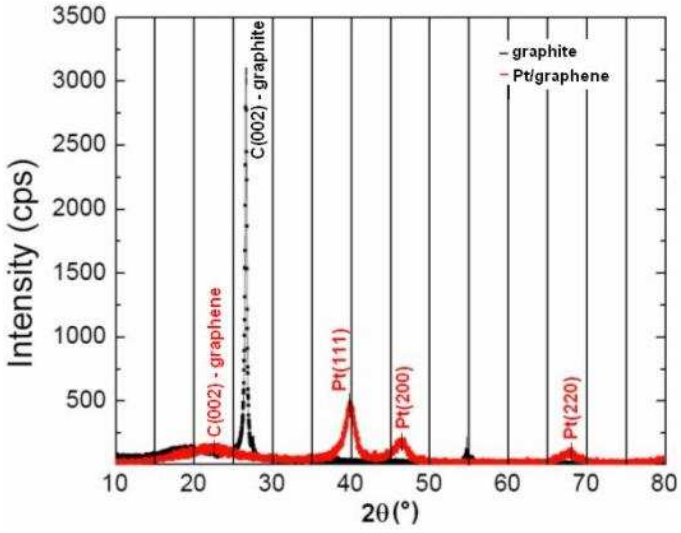

Figure 2: XRD pattern of the Pt/graphene nanocomposite

The presence of different type of oxygen functionalities in graphene and Pt/graphene nanocomposites are illustrated in figure 3.

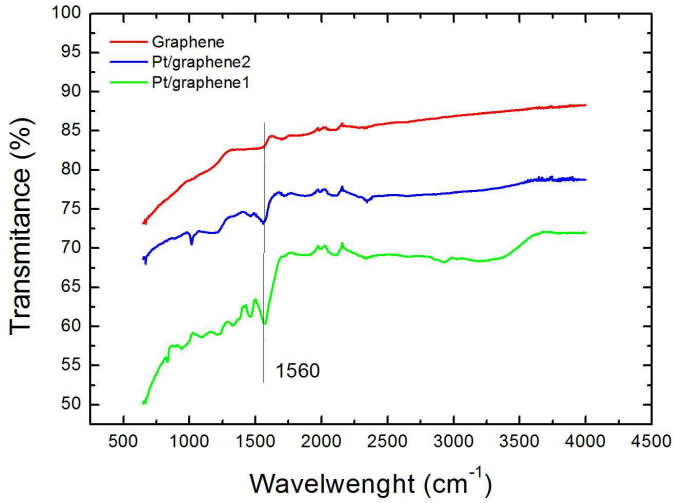

Figure 3: FT-IR spectrum of the graphene and Pt/graphene nanocomposite

Graphene nanocomposites were successfully synthesized through chemical oxidation of graphite followed by exfoliation of graphite oxide and reduction of graphene oxide. The XRD pattern clearly shows the complete disappearance of C(200), indicating the formation of graphene which is also confirmed by SEM images. Also, Pt/graphene nanocomposites are highly compatible to form composite membranes for PEMFC applications. These statements are supported by chemical and physical analyzes.

References

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