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The influence of gamma radiation doses on rGO/Ni for energy storage applications

Metallic nanoparticles (MN) have been the subject of intense research in the last decades because of their high catalytic activity, associated with its large surface-to-volume ratio. However, it is difficult to obtain pure active metal nanoparticles surfaces, since its contamination and aggregation frequently result in deactivation and loss of catalytic activities. MN immobilization can minimize these effects. Thermal, mechanical, and electrical properties of reduced graphene oxide (rGO) make this material an excellent candidate for MN support for batteries and supercapacitors. The production of metallic nanoparticles on rGO surface based on gamma radiation allows less formation of residual impurities, absence of reducing agents, uniform mass production, no aggregation and low costs. Herein, we demonstrated a green and efficient one-step, gamma radiation-based method for Ni/rGO production.
Graphene oxide (GO) was prepared by modified Hummers method. Ni+2 and graphene oxide reduction were performed in water/isopropanol solution (1:1) under inert medium. Samples were irradiated in the Multipurpose Gamma Irradiation Facility at CETER/IPEN/CNEN-SP, a category IV gamma irradiator by the IAEA classification, in radiations doses of 20, 40, and 80 kGy, at 10 kGy/h. From X-ray diffraction, the correlation between radiation doses and crystallite size was evaluated. For supercapacitor studies, cyclic voltammetry was carried out in a screen printed carbon electrode (SPCE) in $K_4[Fe(CN)_6]$. The working electrode was modified with produced rGO-Ni 80 kGy, Pt wire was used as counter and Ag/AgCl as reference electrode. Experiments were performed in KOH 1.0 M.
Results showed that produced Ni/rGO has good potential to be used in electrochemical devices such as supercapacitors or batteries.

Scheme 1- Process to produce reduced graphene oxide /Ni nanocomposite using gamma radiation

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