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Ferrites/reduced graphene oxide (RGO) in supercapacitors: $MnZnFe_2O_4$/RGO- based supercapacitors with superior performance and high stability

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Owing to the rapidly increasing demand for energy conversion devices, energy storage platforms have become significantly attractive more than any instance in the past. Indeed, supercapacitors are considered one of the most promising energy storage devices, due to their excellent reversibility, rapid charge/discharge, high power density, in addition to long-life and cyclic stability compared to the analogous electrochemical energy storage devices. Typically, supercapacitors can be classified into two basic categories, pseudo capacitors, and electrochemical double layer capacitors (EDLC). On the other hand, graphene-based materials are given much consideration as effective electrode materials owing to their high specific surface area, excellent chemical stability, electrical and mechanical properties, and the feasibility for large-scale production of chemically-modified graphene (CMGs). To this end, the Hummers' method is widely used to produce graphene oxides (GO). Herein, the electrochemical performance of the $MnZnFe_2O_4$/RGO colloidal nano needle-based supercapacitors is investigated. Cyclic voltammetry, galvanostatic charge–discharge and cycle stability have been investigated. The obtained results reveal that, the $MnZnFe_2O_4$/RGO colloidal nanorods have a superior specific capacitance higher than $MnZnFe_2O_4$. The $MnZnFe_2O_4$/RGO based- supercapacitors using H_2SO_4 electrolyte demonstrated the best cycle stability among all the supercapacitors.

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Behavior of elastic modulus of nano filled epoxy resin under dynamic mechanical and nano hardness analysis

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A carbon nano material such as multi-walled carbon nanotubes (MWCNTs) and graphene nano platelets (GnPs) has attracted considerable interest over recent years due to its intrinsic mechanical, thermal and electrical properties. Incorporation of small quantity of nano fillers into polymer can create novel nano composites with improved structural and functional properties. The properties of polymers, as reflected by their response to externally applied stresses, are dependent on both time and temperature. The dynamic mechanical analysis (DMA) of polymer-based MWCNT/epoxy resin and GnP/epoxy resin nano composites provides important insight into the intimate conformation of the polymer chains in the sample, as well as the interactions of these chains with MWCNT and GnP components in the composite system. Therefore, dynamic mechanical and nano hardness measurements of MWCNT/epoxy resin and GnP/epoxy resin nano composite were used to evaluate the effect of temperature on dynamic elastic modulus. These provide direct information on various other characteristic structural parameters, such as dynamic viscoelastic behavior, glass transition temperature (Tg), storage and loss moduli, and tan δ. The results of these measurements for all samples were compared, and allowed the evaluation of the effect of a magnetic field on the MWCNT/epoxy resin and GnP/epoxy resin nano composites. It can be seen that the storage modulus decreased with the increase of temperature, whereas loss modulus increased with increase of temperature. At low temperatures, all the samples show a very high value of the storage elastic modulus, followed by gradual drops due to second order transactions between 40°C to 110°C. The principal drop, due to the glass transaction, is evident for all samples in the range 130°C to 140°C. But, tanδ curves show a peak value 150°C to 160°C of temperature range indication glass transaction temperature. This indicates that the addition of nano filler improves the elastic properties of the epoxy system at elevated temperatures in the rubbery region. The loss modulus indicates that the energy has been converted into heat and can thus be used as a measurement of viscous component or unrecoverable oscillation energy dissipated per cycle. It may be further concluded that the nano hardness increases with increase of elastic modulus, as shown in figure.

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