Abstracts & Program

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Synthesis of CoFe$_2$O$_4$–RGO Nanocomposite and Investigation on Its Structural and Magnetic Properties

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In this work, graphene oxide was synthesized by a modified Hummer method. In the first stage of preparation process, light brown color of the precursor was appeared, which means that there are some impurity phase in the outcome product. By changing some parameters such as time of mixing, modification the procedure of mixing materials, increasing the temperature and addition of deionized water and hydrogen peroxide separately, the color of sample turned to mustard yellow. Therefore, it means that graphene oxide without any impurity was gained. Then CoFe$_2$O$_4$ – RGO nanocomposite were prepared by ball-milling at frequency about 25 s$^{-1}$ for 6 h using the necessary raw materials such as Co(NO$_3$)$_2$·6H$_2$O, Fe(NO$_3$)$_3$·9H$_2$O and GO. The resulting mixture was washed with distilled water five times and then freeze-dried.

The exfoliation and reduction of the graphite oxide and decorating of CoFe$_2$O$_4$ nanoparticles on graphene sheets were accomplished in one-step process. Structural, physiochemical and optical properties of the products were investigated with the help of X-ray powder diffraction (XRD), Fourier transform infrared spectroscopy (FTIR) and Ultraviolet–visible spectroscopy (UV - Vis).

XRD patterns of the produced GO did not show any second phase, which reveals the complete oxidation of the graphite powder. Also XRD patterns of the nanocomposite samples had some sharp peaks which is associated with the formation of crystallinity. The average diameter of the CoFe$_2$O$_4$ – RGO crystallite was evaluated by the Debye-Scherrer formula, which obtained 17 nm.

FT-IR results showed that graphite has been oxidized by strong oxidants and the oxygen atoms have been introduced into the graphite layer and formed C=O, C-OH, COOH and C-O-C chemical bonds with graphene. However, some characteristic peaks of the oxygen-containing functional groups in graphene oxide disappeared in the spectrum of nanocomposite sample. Moreover, a new prominent absorption band appeared at about 591 cm$^{-1}$ in the FTIR spectrum of CoFe$_2$O$_4$ – RGO, which corresponds to the stretching mode of Fe (Co)-O.

The surface morphologies of the CoFe$_2$O$4$–RGO hybrids were investigated by scanning electron microscopy (SEM) and transmission electron microscopies (TEM). The TEM and SEM images of the CoFe$_2$O$_4$ – RGO composite showed that CoFe$_2$O$_4$ nanoparticles were decorated on the GO sheets.

Magnetic properties of the CoFe$_2$O$_4$ – RGO nanocomposite were investigated by a Vibration sample magnetometer at room temperature with maximum applied magnetic field of 15000 Oe. CoFe$_2$O$_4$ nanoparticles exhibited a saturation magnetization ($M_s$) of 56.88 emu g$^{-1}$ and remnant magnetization ($M_r$) of
21.44 \text{emu g}^{-1}. The coercive force \(H_c\) of the CoFe₂O₄ nanoparticles was reported to be 507.8 Oe. While by adding graphene oxide these values change to 52 \text{emu g}^{-1}, 9 \text{emu g}^{-1} and 100 Oe respectively. According to magnetic hysteresis loops, CoFe₂O₄ – RGO has magnetic behavior close to that of superparamagnetic.

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**Dispersion of Magnetostatic Surface Waves in a Medium with Damping**

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Magnetostatic surface waves (MSSW) in ferrite films is the basic foundation for microwave analog data processors. Minimization of wave losses is a key for its successful work, but the MSSW damping hasn't been studied enough, as the vast majority of the research is performed without consideration of attenuation. The geometry of task is following. The MSSW is propagated in ferrite slab having thickness \(d\) magnetized by constant magnetic field \(H\). Landau-Lifshitz-Gilbert equation was used to describe the motion of the magnetization vector \(m\) in a lossy medium (with the damping coefficient).

In study were calculated the dispersion curves for the real and imaginary parts of the wave number that were obtained by the numerical solution of dispersion equation. Thus, in this study dispersion relations for the real and imaginary parts of the wave number were obtained. It was shown that dispersion curves are limited both by the wave number and frequency, and these restrictions tighten with an increase in the damping parameter. It was shown that there is a new branch of the inverse dissipative waves, for which there is a critical value of the damping parameter, beyond which it does not exist. With the increase of the angle, limitation of dispersion curves is exacerbated, branches of the dispersion curves are shifted toward lower wave numbers and the damping parameter is being bounded below and above.