The impact of the NZFO content on the synergy effect in NZFO/f-MWCNTs nanocomposites synthesized via ex-situ method

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In a couple of previous years, a new generation of advanced SF-NPs/CNTs materials (SF-NPs - spinel ferrite nanoparticles [1-2], CNTs -carbon nanotubes [3]), retaining the properties of individual components and emphasising the synergic effect, began to be investigated [4-6]. Herein, the comparison between NZFO/f-MWCNTs synthesized via ex-situ method based on $Ni_{0.5}Zn_{0.5}Fe_2O_4$ (NZFO) nanoparticles with 2, 5, 25 and 50 wt.% of NZFO and functionalized multi-walled carbon nanotubes (f-MWCNTs) is analyzed. The structural and microstructural analysis of NZFO/f-MWCNTs composites confirms the efficiency of the synthesis process. The estimated NZFO crystallite size is just slightly varied over NZFO content e.g. from 12.4 nm (2 wt.%) to 11.5 nm (50 wt.%). The magnetic properties analysis revealed the cluster-glass magnetic state of NZFO particles with an apparent maximum in ZFC curves at the T_{max} with values modified from about 155 K (2 wt.%) to 130 K (50 wt.%). The core-shell-like structure with a magnetic core and disordered layer is evidenced. The proven spin-canting effect on the NZFO surface based on the Yafet-Kittel model is discussed. The influence of Fe-based carbon matrix residues in all studied hybrids was detected with prominent domination at the low NZFO content. The redistribution of Fe cations in the A-tetrahedral and B-octahedral lattice site versus NZFO content is proved by X-ray photoemission (XPS) studies.

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