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Influence of Mg-Ni-doped $ZnFe_2O_3$ incorporation on the structural, morphological and band gap properties of ultra-high-molecular-weight polyethylene

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The present study aims at investigating the effect of incorporating nanoscale MgxNixZn-xFe_2O_3 (where x=0.15) as nanofillers on the physical and chemical stability of ultra-high molecular weight polyethylene (UHMWPE). The effect of adding 1% and 2% (by weight) nanofillers on the physical and chemical properties of UHMWPE/MgxNixZn-xFe_2O_3 nanocomposites have also been investigated by using FTIR, Raman, and UV-VIS spectroscopy. FTIR data of UHMWPE/MgxNixZn-xFe_2O_3 nanocomposites reveal that the addition of MgxNixZn-xFe_2O_3 up to 1% induces significant chemical and physical structural alterations in UHMWPE matrix. However, this behavior is found to reduce on increasing the concentration of nanofillers from 1% to 2%. Raman spectroscopic data show that crystalline contents of UHMWPE remain unaffected by the addition of nanofillers, however; a significant increase in amorphous contents and decrease in an all-trans interphase region is observed. This behavior is attributed to the chain scission reactions due to the addition of MgxNixZn-xFe_2O_3 followed by compression molding process at high pressure and elevated temperature. Absorption spectroscopy analysis revealed that the incorporation of MgxNixZn-xFe_2O_3 results in a decrease of energy band gaps from 2.14eV to 2.08eV (for direct transition) and from 1.54eV to 1.38eV (for indirect transition) due to additional sub-bandgap energy levels which are induced because of MgxNixZn-xFe_2O_3 incorporation as nanofillers within the PE matrix.

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