APPLICATION OF $MgFe_2O_4$/PVP NANOCOMPOSITE FOR LDPE FILMS TREATMENT

Tatiana GUTSUL[1], Inna RASTIMESINA[2*], Olga POSTOLACHI[2], Diana INDOITU[2], Vera MAMALIGA[2], Alexandr SIBAEV[1], Igori BELOTERCOVSCHII[1]
[1] Institute of Electronic Engineering and Nanotechnologies "D. Ghitu," Technical University of Moldova, Chisinau, Republic of Moldova
[2] Institute of Microbiology and Biotechnology, Technical University of Moldova, Chisinau, Republic of Moldova

*Corresponding author: inna.rastimesina@imb.utm.md

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Background: Magnesium ferrite nanoparticles ($MgFe_2O_4$ NPs) exhibit intrinsic peroxidase-like activity and have been effectively used as nanozymes – enzyme mimics that catalyze biochemical reactions similarly to natural enzymes. These nanomaterials have been used in wastewater treatment as adsorbents to remove heavy metal ions and as Fenton-like catalysts for break down contaminants. Due to their biocompatibility and low toxicity these nanoferrites find their application in medicine; their semiconducting and superparamagnetic properties are used to set up bioelectronic sensor devices for environmental monitoring.
The aim of this study was to synthesize and to evaluate magnesium ferrite nanocomposites application in the treatment and functional modification of LDPE films.
Materials and methods: Magnesium ferrite nanocomposite was synthesized by chemical reduction procedures. Low-molecular weight poly-N-vinylpyrrolidone (PVP) was used as a stabilizer. The resulting nanocomposite has been characterized by scanning electron microscopy (SEM), X-ray powder diffraction (XRD), and FT-IR spectroscopy.
Results: The obtained $MgFe_2O_4$/PVP nanoparticles are spherical, 5–10 nm in size, and tend to aggregate into 80–120 nm structures due to high surface energy. EDX analysis showed an Mg:Fe ratio of 1:2.5. The nanocomposites exhibited peroxidase-like activity in the 0.01–0.16 μM range. They were applied to LDPE films, which were then incubated in soil from the Țintareni landfill contaminated with plastic waste. Microbial consortia were obtained from the enrichment cultures cultivated on two MSM media, with counts ranging from 12.20×10^6 CFU/ml (MSM 4, pH 6.5) to 27.93×10^6 CFU/ml (MSM 2, pH 5.5). All consortia had mixed composition. A change in the acidity of the culture liquid was observed during the growth of microorganisms on both media: a decrease in pH to 3.9-4.0, which is associated with the predominant development of fungi in the consortia. The micromycetes isolated from the consortia belonged to different genera: *Trichoderma*, *Penicillium*, *Aspergillus*. The isolated bacteria were part of the genus *Pseudomonas* and *Streptomyces*.
Conclusions: Modifying the surface structure of LDPE films by treating polyethylene with $MgFe_2O_4$/PVP nanocomposites can influence the formation of microbial consortia in soil, the titer and composition of microorganisms depend on the initial acidity of medium, and the concentration of the nanocomposite.
Keywords: ferrite nanoparticles, LDPE, plastic waste, microbial consortia

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