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STRUCTURAL AND MAGNETIC PROPERTIES OF Fe60–xNix(ZnO)40NANOCOMPOSITES PRODUCED BY MECHANICAL MILLINGAND COATED BY THERMAL SPRAYING ON A STEEL SUBSTRATE

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Abstract: This work aims to study the effect of mechanical milling of Fe, ZnO, and Ni elemental powders andthermal spraying processes on chemical composition, structural properties, and magnetic behaviorof the Fe60–xNix(ZnO)40 coatings. As the first step, the FeNi/ZnO composite was synthesized bymechanical alloying process, and afterward, the milled powder was coated by a thermal sprayingtechnique on a steel substrate. Obtained samples were characterized by the methods of X-raydiffraction (XRD), scanning electron microscopy (SEM), energy dispersive spectroscopy (EDS),atomic force microscopy (AFM), and with help of vibrating sample magnetometer (VSM). Aftermechanical milling, the crystallite size of the powder decreased from 18 to 10 nm, while the latticestrain increased from 0.31 to 0.59%, and a new solid solution FeNi formed after 20 h of milling dueto diffusion of nickel into the iron lattice. After the thermal spraying process, different phasesappeared in a surface coating such as ZnFe2O4, NiFe2O4, and FeNi. The magnetic and structuralproperties of the coated powders are influenced by the change in chemical composition. Thus, theincrease of Ni concentration improved the soft magnetic performance of the coating significantly.The highest saturation magnetization was determined in Fe40Ni20(ZnO)40 sprayed powder. However,the smallest coercivity appeared in Fe50Ni10(ZnO)40 sprayed powder.

Keywords : FeNi/ZnO nanoparticle coating, Mechanical Alloying, Thermal Spraying, magnetic behavior, Structural properties