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论文

纳米晶 $Ni_{1-x}Zn_xFe_2O_4$铁氧体粉料的制备及其磁性能研究

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摘要

采用喷射-共沉淀法制备了纳米晶Ni1-xZnxFe2O4 (0≤x≤1.0)铁氧体粉料. 通过TG-DSC、XRD、SEM、TEM、BET等测试手段分析了其微观结构和形貌, 用振动样品磁强计测量其室温下磁性能. 结果表明: 喷射-共沉淀法制备的粉料颗粒细小均匀、形状完整. 600℃下煅烧1.5h, 样品晶粒尺寸为30nm左右, 平均颗粒尺寸<100nm. 室温下, 样品比饱和磁化强度随Zn^{2+}含量增加而变化, 当x=0.5时, 最大比饱和磁化强度σ_s为66.8A·m^2/kg. 当晶粒大小为41nm时, 纳米晶$Ni_{0.5}Zn_{0.5}Fe_2O_4$铁氧体矫顽力达到最大值5.06kA/m, 随后又随晶粒尺寸增大而减小. 这归因于纳米晶软磁材料中强烈的无序磁晶各向异性模式的影响.

关键词 纳米材料 Ni1-xZnxFe2O4铁氧体 喷射-共沉淀法 磁性能

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Synthesis and Magnetic Properties of Nanocrystalline $Ni_{1-x}Zn_xFe_2O_4$ Ferrite

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Abstract

Nanocrystalline $Ni_{1-x}Zn_xFe_2O_4$ ferrite with $0 \le x \le 1$, was successfully prepared by a spraying-coprecipitation method. The microstructure was investigated by using TG-DSC, XRD, SEM, TEM as well as BET. Magnetic properties were measured with a vibrating sample magnetometer (VSM) at room temperature. The results show that uniform and fine nanocrystalline $Ni_{1-x}Zn_xFe_2O_4$ ferrite powders are obtained by the spraying-coprecipitation method. The grain size is about 30 nm calcined at 600 for 1.5h. There are a few agglomerates with average sizes below 100nm. The specific saturation magnetization of nanocrystalline$Ni_{1-x}Zn_xFe_2O_4$ ferrite increases with the concent of Zn^{2+} at room temperature, and maximum σs is 66.8A·m^2/kg as the content of Zn^{2+} is around 0.5. When the grain size is 41nm, the coercivity Hc of nanocrystalline Ni0.5Zn0.5Fe2O4 ferrite arrives at 5.06kA/m, and then it decreases with the increase of the grain size. The results may be explained in terms of intense random magnetocrystalline anisotropy model in nanocrystalline materials.

Key words nanocrystalline materials Ni1-xZnxFe2O4 ferrite spraying-coprecipitation method magnetic properties

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