Comparison of structure and magnetic properties of Mn–Zn ferrite mechanochemically synthesized under argon and oxygen atmospheres

ABSTRACT

Nanocrystalline Mn0.5Zn0.5Fe2O4 ferrite was successfully synthesized by ball milling a powder mixture of MnO, ZnO, and Fe2O3 under argon and oxygen atmospheres. The effects of the milling time, milling atmosphere, and annealing temperature on the milled powders were examined. X-ray diffractometry (XRD), scanning electron microscopy, and transmission electron microscopy were used to evaluate the powder particle structure. The XRD results indicated that after 20 h of ball milling the MnOï ZnOï Fe2O3 powder reacted with a solid-state diffusion reaction route producing Mnï Zn ferrite nanoparticles in the milled samples with both atmospheres. However, some Fe3O4 phase alongside Mnï Zn ferrite, both being spinel-phase, was detected for 40 h milled powders in the argon atmosphere. Those milled powders in the argon atmosphere had smaller crystallite size than the other ones. In the final stage of milling (40 h), the average crystallite size and lattice strain were 20 nm and 0.51%, respectively, ans 25 nm and 0.48% for milled samples in the argon and oxygen atmospheres, respectively. Vibrating sample magnetometer results indicate that the saturation magnetization and coercivity were 34 emu/g and 30 Oe, 18 emu/g and 70 Oe, respectively, for the 40 h milled samples in argon and oxygen, which were annealed at 800 °C for 2 h.

Keyword: Mn0.5Zn0.5Fe2O4 ferrite; Ball milling; Argon; Oxygen; Milling