Effect of milling atmosphere on structural and magnetic properties of Ni–Zn ferrite nanocrystalline

ABSTRACT

Powder mixtures of Zn, NiO, and Fe2O3 are mechanically alloyed by high energy ball milling to produce Niï Zn ferrite with a nominal composition of Ni0.36Zn0.64Fe2O4. The effects of milling atmospheres (argon, air, and oxygen), milling time (from 0 to 30 h) and heat treatment are studied. The products are characterized using x-ray diffractometry, field emission scanning electron microscopy equipped with energy-dispersive x-ray spectroscopy, and transmitted electron microscopy. The results indicate that the desired ferrite is not produced during the milling in the samples milled under either air or oxygen atmospheres. In those samples milled under argon, however, Zn/NiO/Fe2O3 reacts with a solid-state diffusion mode to produce Niï Zn ferrite nanocrystalline in a size of 8 nm after 30-h-milling. The average crystallite sizes decrease to 9 nm and 10 nm in 30-h-milling samples under air and oxygen atmospheres, respectively. Annealing the 30-h-milling samples at 600 °C for 2 h leads to the formation of a single phase of Niï Zn ferrite, an increase of crystallite size, and a reduction of internal lattice strain. Finally, the effects of the milling atmosphere and heating temperature on the magnetic properties of the 30-h-milling samples are investigated.

Keyword: Magnetic property; Mechanical alloying; Milling atmosphere; Milling time; Ni-Zn ferrite nanocrystalline