

Parametric optimization of NiFe₂O₄ nanoparticles synthesized by mechanical alloying

ABSTRACT

In this study, the Taguchi robust design method is used for optimizing ball milling parameters including milling time, rotation speed and ball to powder weight ratio in the planetary ball milling of nanostructured nickel ferrite powder. In fact, the current work deals with NiFe₂O₄ nanoparticles mechanochemically synthesized from NiO and Fe₂O₃ powders. The Taguchi robust design technique of system optimization with the L₉ orthogonal array is performed to verify the best experimental levels and contribution percentages (%) of each parameter. Particle size measurement using SEM gives the average particle size value in the range of 59-67 nm. X-ray diffraction using Cu K α radiation is also carried out to identify the formation of NiFe₂O₄ single phase. The XRD results suggest that NiFe₂O₄ with a crystallite size of about 12 nm is present in 30 h activated specimens. Furthermore, based on the results of the Taguchi approach the greatest effect on particle size (42.10 %) is found to be due to rotation speed followed by milling time (37.08 %) while ball to powder weight ratio exhibits the least influence.

Keyword: Crystal structure; Magnetic materials; Microstructure; X-ray diffraction