

Annealing study of α -Fe₂O₃ nanoparticles steel-waste based: microstructure and magnetic behavior

ABSTRACT

The interest of this paper is to show the influence of annealing process on magnetic properties and microstructure of γ -Fe₂O₃ derived from steel waste product (mill scales). The mill scales flakes were wet ball milling for several hours to form a fine powder. The mill scales powder was purified by using magnetic separation to isolate the magnetic and non magnetic particles. The method was continue for Curie temperature separation technique. The purified powder was annealed at 400/450/500 and 550 °C at 6 oC/mins to form hematite, α -Fe₂O₃. The annealed powders were milled for several hours by using mechanical alloying. Annealing at varied temperatures produced α -Fe₂O₃ nanopowders with average crystallite size 18.1 nm to 28.6 nm. Phase transformation occurred directly by annealing in air, conversion of FeO and Fe₃O₄ phase to form α -Fe₂O₃. The correlation between the magnetic properties and microstructure, of the sintered powders at 1200 oC enables to obtain microphase of α -Fe₂O₃ and Fe₃O₄ with different particle size and magnetic properties. The resultant α -Fe₂O₃ nanopowders are ferromagnetic with moderate coercivities.

Keyword: Fe₂O₃; Steel waste; Particle size; Magnetic properties; Mechanical alloying