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Original Article

Effect of heat-treatment temperature and zinc addition on magnetostructural and surface properties of manganese nanoferrite prepared by an ecofriendly sol–gel synthesis

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ABSTRACT

$Zn_xMn_{1-x}Fe_2O_4@SiO_2$ nanocomposites (NCs) (x = 0.00, 0.25, 0.50, 0.75, 1.00) were prepared by eco-friendly sol–gel synthesis followed by heat treatment at different temperatures and characterized. The X-ray diffraction shows poorly crystallized ferrite after the heat treatment at low temperatures and highly crystalline ferrite accompanied by several secondary phases at high temperatures. The crystallite size increases from 2.4 to 45.2 nm with the increase of heat treatment temperature. The specific surface decreases from 281 to 13 m^2/g with the increase of the heat treatment temperature, reaching values below 1 m^2/g at 1200 °C. All NCs have pores within the mesoporous range, with high dispersion of pores' sizes. The NCs show ferrimagnetic behavior, close to the superparamagentic limit. The main magnetic parameters, saturation magnetization, remanence, coercivity and magnetic anisotropy constant of $Zn_xMn_{1-x}Fe_2O_4@SiO_2$ nanoparticles increase with the increase of particle size and heat treatment temperature and decrease with increase of Zn content. This behavior could be explained presuming that the Zn^{2+}, Mn^{2+} and Fe^{3+} ions can simultaneously occupy both the tetrahedral and octahedral sites in the $Zn_xMn_{1-x}Fe_2O_4$ ferrite.

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