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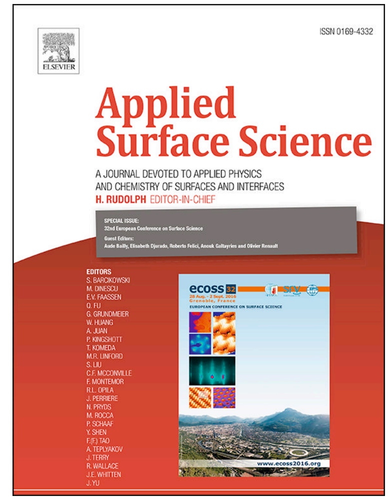

Full Length Article

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ACCEPTED MANUSCRIPT

Study of Iron Oxide Magnetic Nanoparticles Obtained via Pulsed Laser Ablation of Iron in Air

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Abstract

Magnetic nanoparticles were obtained using the nanosecond pulsed laser ablation (Nd:YAG laser, 1064 nm, 7 ns) of an iron target in air at atmospheric pressure. The particles obtained were further annealed at four different temperatures. The composition, structure and properties of all obtained powders were investigated using X-ray diffraction (XRD), DSC, attenuated total reflection Fourier-transform infrared spectroscopy (ATR-FTIR), Raman spectroscopy, TEM, SAED and other techniques. The initial sample was found to contain monoclinic magnetite and iron nitrides. Presumably, magnetite presents in the form of spherical particles with the distribution maximum of 12–15 nm, and nitrides take the form of lamellas and rolls. Thermal treatment of the sample led to particle enlargement and phase transformations, first, to cubic magnetite, then to a Fe_3O_4, α-Fe_2O_3 and γ-Fe_2O_3 mixture, and finally to the pure hematite phase. Zeta-potential, BET surface area and magnetic properties changed with the annealing as well. The obtained materials exhibited different properties that make them in demand in different fields, from biomedicine to technology.

Keywords: pulsed laser ablation in air, iron oxide, nanostructures, magnetic properties, thermal transformation.

Introduction

Pulsed laser ablation (PLA) is a suitable method for obtaining of the “pure nanoparticles” of various materials without use or with a minimal amount of chemical precursors [1]. Currently, the most widespread method of PLA is performed in a liquid, which allows nanoparticles (NPs) to be obtained straightly in the form of colloids [2]. The greatest progress in understanding the ablation mechanisms has been achieved in the PLA of noble metal NPs [3,4] and in the synthesis of a number of oxides obtained by the PLA of targets made of reactive materials [5,6]. However,

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