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Influence of Calcium Ions on the Structural and Magnetic Properties of Cd-Mg Ferrites Nanoparticles

By: Zaki, HM (Zaki, H. M.)^[1,2]; Al-Heniti, S (Al-Heniti, S.)^[1]

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JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY

Volume: 12 Issue: 9 Pages: 7126-7131

DOI: 10.1166/jnn.2012.6586

Published: SEP 2012

[View Journal Impact](#)

Abstract

Cadmium magnesium ferrites doped with calcium having the chemical formula $Cd_{0.5}Mg_{0.5-x}Ca_xFe_2O_4$ ($0.0 \leq x \leq 0.3$) were prepared by the Co-precipitation method. X-ray diffraction analysis confirmed the formation of a single phase with spinel crystal structure for the samples. The lattice parameter is determined for each composition and has been found to increase from 8.505 angstrom to 8.626 angstrom with increasing calcium concentration. Cation distribution for the studied ferrite system is proposed in terms of the structural and magnetic properties by means of X-ray diffraction (XRD), infrared spectroscopy (IR), vibrating sample magnetometer (VSM) and is found to be reliable. The experimental and theoretical lattice constants show the same trend with increasing calcium concentration indicating the validity of the proposed cation distribution. The analysis of infrared spectra indicates the presence of splitting in the absorption band which may be attributed to the presence of small amounts of Fe^{2+} ions in the ferrite system. The appearance of a shoulder around 700 cm^{-1} suggests the presence of calcium ions in the tetrahedral site. The addition of non magnetic calcium ions in the ferrites suppressed the A-interaction and developed a B B interaction, which is reflected in reducing the saturation magnetization in the present samples. The coercive field (H-c) is also found to increase by increasing of Ca^{2+} concentration and has been explained on the bases of direct relationship with anisotropy constant.

Keywords

Author Keywords: Ferrites; Nano-Particles; Co-Precipitation; Magnetization; Cation Distribution

KeyWords Plus: ELECTRICAL-PROPERTIES; CADMIUM FERRITE; X-RAY; SYSTEM

Author Information

Reprint Address: Al-Heniti, S (reprint author)

 King Abdulaziz Univ, Fac Sci, Dept Phys, POB 80203, Jeddah 21589, Saudi Arabia.

Addresses:

 [1] King Abdulaziz Univ, Fac Sci, Dept Phys, Jeddah 21589, Saudi Arabia

 [2] Zagazig Univ, Fac Sci, Dept Phys, Zagazig, Egypt

Funding

Funding Agency	Grant Number
King Abdulaziz University, Jeddah, Saudi Arabia	91-130-D1432

[View funding text](#)

Publisher

AMER SCIENTIFIC PUBLISHERS, 26650 THE OLD RD, STE 208, VALENCIA, CA 91381-0751 USA

Categories / Classification

Research Areas: Chemistry; Science & Technology - Other Topics; Materials Science; Physics

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Document Information

Document Type: Article

Language: English

Accession Number: WOS:000308856200036

PubMed ID: 23035443

ISSN: 1533-4880

Journal Information

Table of Contents: [Current Contents Connect](#)

Impact Factor: [Journal Citation Reports](#)

Other Information

IDS Number: 006YR

Cited References in Web of Science Core Collection: **21**

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