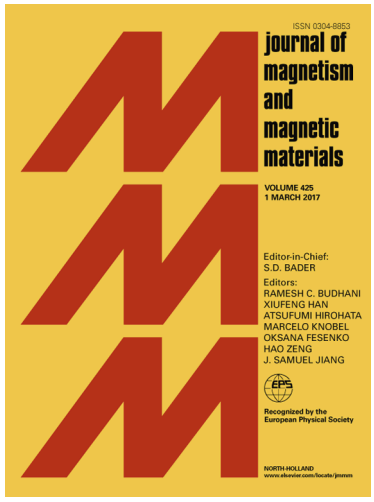

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PII: S0304-8853(17)31872-3
DOI: https://doi.org/10.1016/j.jmmm.2017.09.051
Reference: MAGMA 63181

To appear in: *Journal of Magnetism and Magnetic Materials*

Received Date: 22 June 2017
Revised Date: 11 August 2017
Accepted Date: 20 September 2017

Please cite this article as: S. Naseem, W. Khan, S. Khan, S. Husain, A. Ahmad, Dielectric response and room temperature ferromagnetism in Cr doped anatase TiO_2 nanoparticles, *Journal of Magnetism and Magnetic Materials* (2017), doi: https://doi.org/10.1016/j.jmmm.2017.09.051

Dielectric response and room temperature ferromagnetism in Cr doped anatase TiO_2 nanoparticles

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Abstract:

In the present work, nanocrystalline samples of $Ti_{1-x}Cr_xO_2$ (x=0, 0.02, 0.04, 0.06 and 0.08) samples in anatase phase were synthesized through simple and cost effective acid modified sol gel method. The influence of Cr doping on thermal, microstructural, electrical and magnetic properties was investigated in TiO_2 host matrix. The surface morphology has revealed less agglomeration and considerable reduction in particle size of the nanoparticles (NPs) in case of Cr doped TiO_2 as compared to undoped TiO_2. Energy dispersive x-ray spectroscopy (EDS), Raman and x-ray photoelectron spectroscopy (XPS) established high purity, appropriate stoichiometry and oxidation states of the compositions. The dielectric properties of the nanoparticles were altered by the doping concentration, applied frequency as well as temperature variation. The variation in dielectric constant (??′), dielectric loss (δ) and ac conductivity as a function of frequency and temperature at different doping concentration of Cr were interpreted in the light of Maxwell Wagner theory, space charge polarization mechanism and drift mobility of charge carriers. Both undoped and Cr doped TiO_2 samples exhibit room temperature ferromagnetism (RTFM) that remarkably influenced by means of the Cr content. The significant enhancement in the magnetization was observed at 4% Cr doping. However, decrease in magnetization for higher doping signify antiferromagnetic interactions between Cr ions or superexchange interactions. These results reveal that the oxygen vacancies play a crucial role to initiate the RTFM. Therefore, the present investigation suggests the potential applications of Cr doped TiO_2 nanoparticles for spintronics application.

Keywords: Cr doped TiO_2 nanoparticles; Raman scattering; XPS; Dielectric properties; Room temperature ferromagnetism

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