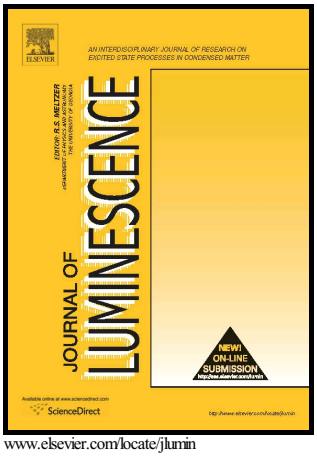

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Consequences of (Cr/Co) co-doping on the microstructure, optical and magnetic properties of microwave assisted sol-gel derived TiO_2 nanoparticles

Swaleha Naseem[1], Wasi Khan[2,*], Shakeel Khan[1], Shahid Husain[2] and Abid Ahmad[3]

[1]*Department of Applied Physics, Z.H. College of Engineering & Technology, Aligarh Muslim University, Aligarh-202 002, India*

[2]*Department of Physics, Aligarh Muslim University, Aligarh-202 002, India*

[3]*School of Materials Science and Engineering, Tsinghua University, Beijing-100 084, China*

Abstract

In the present work, codoped nanoparticles (NPs) of chemical formula $Ti_{1-x}Cr_{x/2}Co_{x/2}O_2$ (x= 0, 0.04 and 0.06) were synthesized by microwave assisted sol-gel method and characterized for their microstructural, compositional and magnetic properties. Rietveld refinement of the x-ray diffraction data and Raman spectroscopy confirm the single phase nature of all the compositions with anatase tetragonal structure. TEM images reveal the variation in the shape and size of the particles with the increase in Cr/Co doping. Fourier transform infrared (FTIR) spectra described the different stretching and vibrational modes related to the functional groups that exist in the samples. Raman and x-ray photoelectron spectroscopy (XPS) establish highly pure, appropriate stoichiometric nature and oxidation state of the compositions. A red shift in the UV-visible absorbance spectra is observed for the codoped samples that signify the bandgap narrowing (i.e. from 3.04 to 2.92 eV) attributed to the formation of defects in the host lattice. Analysis of photoluminescence spectra shows that the dopant ions alter the oxygen vacancies that directly influence the electron hole recombination rate. The magnetic hysteresis loops of 2% and 3% Cr/Co doped samples exhibit room temperature ferromagnetic (RTFM) nature. The value of saturation magnetization enhances with the increase of Cr/Co concentration. These results strongly suggest that the oxygen vacancies play a pivotal role to induce ferromagnetism at room temperature in oxide semiconductors and these oxides are potential candidate for spintronics device applications.