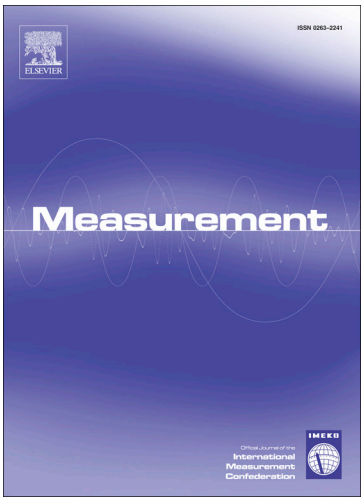

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PII: S0263-2241(17)30527-4
DOI: http://dx.doi.org/10.1016/j.measurement.2017.08.028
Reference: MEASUR 4926

To appear in: *Measurement*

Received Date: 8 June 2017
Revised Date: 21 July 2017
Accepted Date: 17 August 2017

Please cite this article as: S.M. El-Sayed, M.A. Amer, T.M. Meaz, N.M. Deghiedy, H.A. El-Shershaby, Effect of Radiation on the Structure and Optical Absorption Properties for Binary Oxide System, *Measurement* (2017), doi: http://dx.doi.org/10.1016/j.measurement.2017.08.028

Effect of Radiation on the Structure and Optical Absorption Properties for Binary Oxide System

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Abstract

The samples of pure MgO, TiO_2 and MgO-TiO_2 oxides with different MgO molar ratios were synthesized by sol-gel method. The synthesized samples were characterized by various analytical techniques such as energy dispersive X-ray analysis (EDX), X-Ray diffraction (XRD), transmission electron microscopy (TEM) and ultra violet visible spectrophotometry (UV-VIS). The influence of different irradiation doses on the structure and absorption properties of the prepared oxides samples was investigated. Using the analytical method from XRD, the crystal lattice in addition to the surface area, molar volume and the oxygen packing density have been estimated for the irradiated and un-irradiated samples. The induced changes in optical absorption measurements have been observed and the results reflected a great dependence of the fundamental absorption edge on the irradiation dose. The oscillator, dipole strength and dipole moment were also investigated in this study and changes were observed at elevated irradiation dose. Furthermore, the surface morphology in the binary oxides was discussed with respect to higher MgO molar ratios.

Keyword: X-ray diffraction technique, Optical parameters, Transmission electron microscopy, Gamma irradiation.

1. Introduction

Studying the gamma radiation effect on metal oxides has drawn the attention of several researches due to its ability to tune the oxides physical properties. This effect includes restoring the ordered structure of the crystal, dislocations, defects and electron–hole pairs generated in the lattice [1]. Generally, irradiated and un-irradiated metal oxides as MgO and TiO_2 have several applications all over the world pertaining to their remarkable properties. The electronic properties are seriously affected by irradiation and thus significant changes in both the microstructure and optical properties of the material are exhibited. The gamma irradiation studies on TiO_2 with doses from 30 to 150 kGy, are found to cause surface changes, with no significant effect on crystal structure[2]. The bulk lattice constants of rutile TiO_2 are built up of neutral O-Ti-O tri-layers with rows of two-fold coordinated bridging oxygen and in the next layer there are two types of Ti: 6-fold coordinated Ti and exposed 5-fold coordinated Ti [3]. Rutile TiO_2 has strong ultraviolet light absorbing capabilities which can be achieved in some narrow energy regions in various fields [4]. Exposure to irradiation caused damage in the TiO_2 lattice, affecting it's iso-electronic properties and enhancing the catalytic activity reaching it's maximum after a dose of 28 kGy [2, 5].On the other hand, dense powder of magnesium oxide is found to be crystallized in the cubic phase with higher average nanocrystal size [6]. Moreover, the band