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Influence of O_2 pressure on structural, morphological and optical properties of TiO_2-SiO_2 composite thin films prepared by Pulsed Laser Deposition

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ABSTRACT

In this work, TiO_2-SiO_2 composite films were grown on amorphous quartz substrate at different oxygen partial pressure by pulsed laser deposition technique. The influence of oxygen partial pressure on structural, optical and surface properties of films was examined. Grazing incidence X-Ray diffraction showed the formation of TiO_2 rutile phase and degree of crystallinity decreased with the increase of oxygen pressure. Energy band gap of the films increased from 3.3 to 3.6 eV with the increase of oxygen pressure from 13.33×10^{-3} Pa to 20.00 Pa. Variation of surface morphology of films with increasing oxygen partial pressure was studied by Atomic Force Microscopy (AFM). AFM images are showing that grain size of deposited films is increasing with increasing oxygen pressure. Field effect scanning electron microscopy images also shows the similar surface morphology. X-ray Photoelectron Spectroscopy shows the evidence of oxygen defect and related Ti^{3+} states in composite films. Composite films showed blue photoluminescence (PL) emission by the excitation of 350 nm wavelength. Deconvoluted PL peaks showed emission originated from Ti^{3+} defect level associated with an oxygen vacancy. Oxygen vacancy decreased with increasing oxygen pressure. Intense blue emission with high luminous efficacy of radiation and maximum flux was achieved for 13.33×10^{-3} Pa oxygen pressure. Deposited films might be used in the field of blue light emitting diode application.