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Niobium Doped TiO₂ (Nb:TiO₂) : Effects of Doping Concentration on the Optical Properties of TiO₂

P. Ajuoga*, A. Ogacho, J. Mwabora and B. Aduda

Department of Physics, University of Nairobi, P.O. Box 30197- 00100 GPO Nairobi-Kenya

The optical band gaps and crystal structure were investigated on niobium doped TiO₂ (for atomic niobium concentrations ranging from 0.02 –0.06 at. % in the composite) prepared by high temperature diffusion method. The Nb:TiO₂ films displayed an enhanced visible light absorption with a red shift of 18.2 nm of the optical absorption edge from 394 nm for pure TiO₂ film to 412.2 nm for 0.04 at. % niobium concentration representing a band gap lowering of 0.181eV due to the donor-type behavior of niobium. As the niobium concentration increased, the enhancement in light absorption at the investigated concentration range goes through a maximum at 0.04 at. % of Nb⁵⁺ with minimum band gap of 3.017eV. Despite higher rutilization, at the doping temperature of 850°C used, crystal sizes (39–43 nm) obtained from X-ray diffraction spectra depicted a significant increase in surface areas which is attributed to retardation of anatase - rutile phase transformation caused by Nb:TiO₂ matrix.

*Corresponding author email: ajuogapw@yahoo.com

Key words: Anatase, atomic percent (at. %), Nb:TiO₂ rutile, rutilization
