Effect of 120 MeV Ti^{+9} ion irradiation induced modifications in structural, optical, morphological and electrical properties of titanium dioxide and tin oxide nanocomposite thin films

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ABSTRACT

Ion beam irradiation technique plays a crucial role for modifications in structural, optical, surface morphological and electrical properties of material [1]. The energy loss of the incident ions described by the mean depth at which particle is embedded. Trajectory of incident ion described by the elastic and inelastic collision, high energetic ions (>2MeV) interact inelastically with the target and electronic energy stopping (S_e) occur similarly low energetic ions (<2MeV) interact elastically with the target and nuclear energy stopping (S_n) occur. These energy losses are the cause of modification in the properties of material.

In the present communication, we have study the effect of swift heavy ion induced modification in nanocomposite thin films of tin oxide (SnO_2) & titanium dioxide (TiO_2) were grown on silicon and ITO substrate by RF Sputtering technique according to their atomic mass percent ratio 3:1. Irradiated with Swift Heavy Ion (SHI) beam of 120 MeV Ti^{+9} ion with varying ion fluence from 5×10^{11} ions/cm^2 to 3×10^{13} ions/cm^2. The optical band gap for pristine and irradiated samples were studied by UV/Visible technique shows in fig. 1(A, B) and optical bandgap decreased from 3.93 eV to 3.77 eV. This is attributed to generation of local energy states, variation in particle size and scattering due to surface roughness. Electrical properties were studied by I-V characteristics at room temperature and low temperature R-T curve. Surface morphology studies by Atomic Force Microscopy (AFM) technique shows grain size dependence on irradiation fluence. The calculated roughness exponent and rms roughness with respect to irradiation fluence varies with irradiation fluence. Particle size and phase transformation was studied by X-ray diffraction (XRD) technique. The particle size was calculated (23.97 nm) using Debye-Scherrer's formula and XRD pattern was presented in fig. 1(C). Based on uniform deformation model (UDM), the strain in these thin films were calculated using XRD data. Depth profiling and elemental analysis was done by Rutherford Backscattering Spectroscopy technique. Detailed results will be discussed during the presentation.

Key Words: SHI, UV-Visible, XRD, I-V, AFM, RBS.

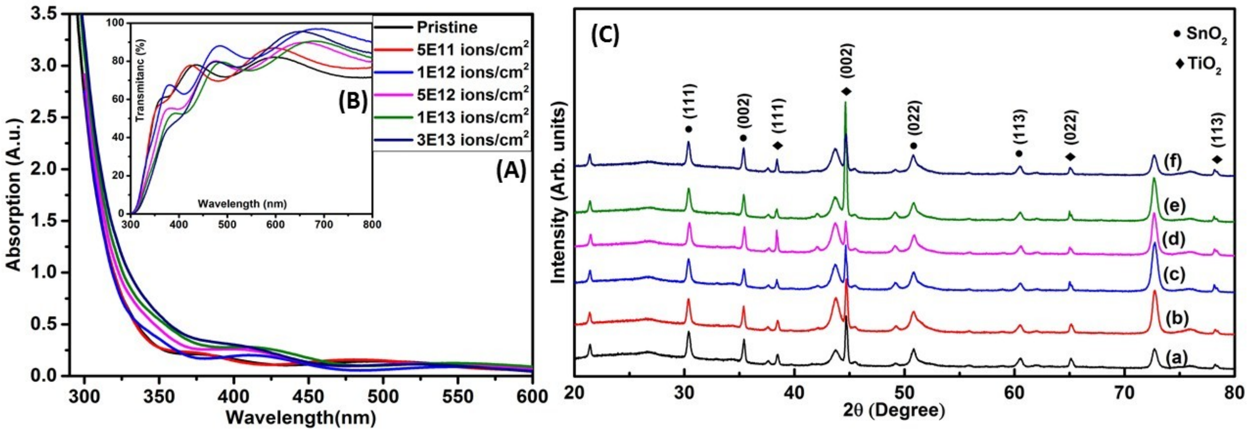

Fig. 1 (A) Absorption plot, (B) Transmittance plot, (C) XRD plot of pristine and 120 MeV Ti^{+9} irradiated samples with varying ion fluence.

Reference:

1 M. K. Jaiswal, R. Kumar, D. Kanjilal, C. Dong, C. Chen, K. Asokan, and S. Ojha., Studies of dense electronic excitation-induced modification in crystalline Fe-doped SnO2 thin films. *Applied Surface Science.* **332**, 726 (2015).