Role of Ion Beams in $SrTiO_3$ and their Characterizations by Synchrotron Based Techniques

K. Asokan[a], Vishnu Kumar[b], Anuradha Bhogra[a] C.L. Dong[c], C.L. Chen[d], S. Annapoorni[b],

[a]*Inter University Accelerator Centre, Aruna Asaft Ali Marg, New Delhi-110067 India*
[b]*Department of Physics and Astrophysics, University of Delhi, Delhi 110 0 07 India*
[c]*Department of Physics, Tamkang University, Tamsui 25137, Taiwan*
[d]*National Synchrotron Radiation Research Center, Hsinchu 30076, Taiwan*

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The quantum materials encompass various materials and phenomena leading to new dimensions. Understanding the role of ion beams in these materials like $SrTiO_3$ (STO) using synchrotron-based characterization like x-ray diffraction (XRD), Photoluminescence (PL), and X-ray Absorption Near-Edge Structure (XANES) spectroscopic techniques may lead to novel properties and applications [1-3]. We report the evolution of optical intense blue-green emission in 100 keV nitrogen (N) ion implanted STO thin films. The XRD pattern shows a change in reflections at lower N ion fluences and the amorphization of the films at higher fluencies. A disordered phase induced by implantation in the STO films leads to an intense blue-green emission due to oxygen (O) vacancies and N (2*p*) bound states. A schematic diagram of energy levels has been proposed to explain the origin of PL emission. The XANES spectra at Ti *K* edge reflect a change in the valency of Ti ions and the local atomic structure of ordered and disordered phases of STO with an increase in N ion fluence. The splitting of peak assigned to e_g orbitals, and change in ratio $d_z^2/d_{x^2-y^2}$ observed in the Ti *L*- and O *K*-edge spectra, confirm a distortion in TiO_6 octahedral structure and modifications in O 2*p*-Ti 3*d* hybridization states. The synchrotron-based techniques reveal that N ion implanted STO can be a good photoluminescent material exhibiting a variety of emissions through bound states of O vacancies and implanted N ions. Similar investigations were also carried out to understand the changes in the electrical and thermoelectrical properties of N ion implanted STO[3].

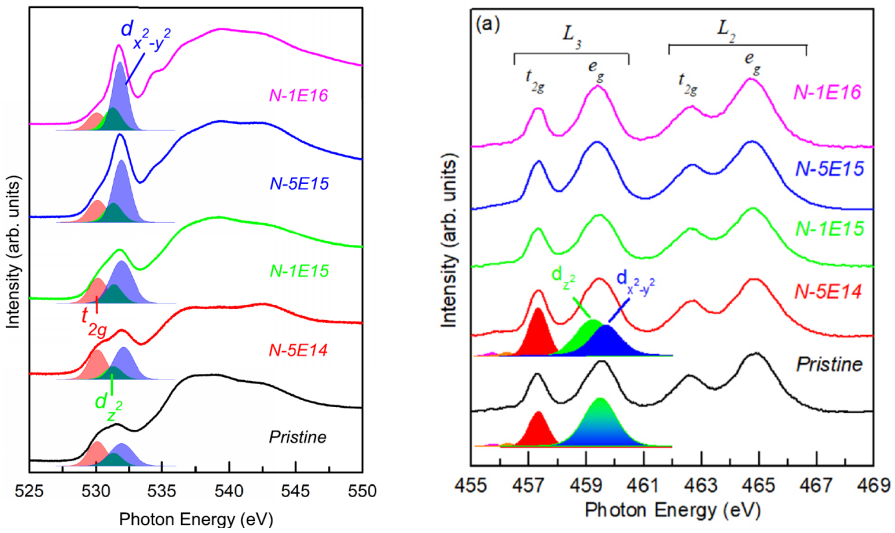

FIGURE 1. The normalized XANES spectra at (i) O K-edge and (ii) Ti L-edges of N ion implanted STO thin films. Note the evolution of spectral features with N ion implantations [1].

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