



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student : Sasmita Behera

Roll Number : 146121030

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Thesis Title: Influence of Cu Nano-Layer on Nonlinear Optical Response of BTO, STO and BST Thin Films Fabricated via Pulsed Laser Deposition

Name of Thesis Supervisor(s) : Prof. Alike Khare

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SHORT ABSTRACT

The present thesis was focused on the fabrication and characterization of perovskite thin films of BaTiO_3 , SrTiO_3 , $\text{Ba}_{1-x}\text{Sr}_x\text{TiO}_3$ ($0 \leq x \leq 1$) via pulsed laser deposition (PLD) technique. The optimized substrate temperature and background oxygen pressure were found to be 700°C and 0.1 mbar, respectively. The morphology, structural, linear, and nonlinear optical properties of all thin films were studied by AFM and FESEM, XRD, Raman, UV-Visible-NIR spectroscopy, and modified Z-scan technique. The values of nonlinear absorption coefficient (β) for BaTiO_3 , SrTiO_3 , and $\text{Ba}_{0.5}\text{Sr}_{0.5}\text{TiO}_3$ thin films fabricated at optimized conditions were found to be (57.54 ± 0.05) , (63.51 ± 0.13) , (73.24 ± 0.32) cm/W, respectively. It has already been known that the NLO properties can be further enhanced by embedding with metallic nanoparticles. Therefore, the effect of Cu nano-layer on structural, linear, and nonlinear optical properties of host matrix of BaTiO_3 , SrTiO_3 , and $\text{Ba}_{0.5}\text{Sr}_{0.5}\text{TiO}_3$ thin films have been studied and observed that the sequence of Cu nano-layer is important for SPR and enhancement in NLO properties. The nonlinear absorption coefficients (β) of Cu infused BaTiO_3 , SrTiO_3 , and $\text{Ba}_{0.5}\text{Sr}_{0.5}\text{TiO}_3$ thin films were found to be (155.04 ± 5.39) , (182.34 ± 7.23) and (188 ± 0.45) cm/W, respectively. The values of the third-order nonlinear optical coefficients (β , n_2 , and $\chi^{(3)}$) in $\text{Ba}_{1-x}\text{Sr}_x\text{TiO}_3$ ($0 \leq x \leq 1$) thin films were found to be in the range of $(64.74 - 74.85)$ cm/W, $(0.18 - 6.35) \times 10^{-3}$ cm²/W and $(12.43 - 63.11) \times 10^{-4}$ esu, respectively. The optical limiting response of BaTiO_3 , SrTiO_3 , and $\text{Ba}_{0.5}\text{Sr}_{0.5}\text{TiO}_3$ thin films deposited on quartz and MgO substrates was analysed and measured the optical limiting threshold as well. The obtained high third-order nonlinearity and low optical limiting threshold in present films are promising for optoelectronics and photonics devices and can be used as optical limiters and optical switching applications.