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Topic of Research: Nano-structured Ferroelectric Thin Films: Growth and Characterization

FINDING

Over the last two decades, many research efforts have been dedicated toward the improvement of materials to attain high optical nonlinearity, motivated by the prospective applications of various nonlinear optical related phenomena. Third-order nonlinear optical materials have piqued the interest of researchers due to their potential uses in data storage, optical communication, optical computation, optical modulation, and optical switching. These materials should exhibit high optical nonlinearities and a rapid response, particularly in the femtosecond (fs) time domain. In view of the preceding discussion, the present work proposed nanostructured ferroelectric (PZT) thin films and ferroelectric-semiconductor (PZT-ZnO) heterostructures as nonlinear optical materials by investigating their third-order nonlinear optical properties via theoretical calculations based on UV-Vis data. The current thesis compares the structural and optical properties of PZT (52/48) bulk form (powder) with PZT (52/48) thin film on ITO substrate, prepared via solid-state reaction and sol-gel spin-coating technique, respectively. The structural properties have been determined by XRD, SEM and Raman. The optical properties have been evaluated via the absorbance, transmittance and reflectance spectra obtained via UV-Vis spectroscopy. A comparative review for variation in band gap energies has been presented. This is followed up by an investigation of the effects of substrates on the structural and optical properties of PZT (52/48) thin films prepared via sol-gel spin-coating technique. It presents the XRD analysis, SEM studies, Raman investigation and UV-Vis studies of PZT thin films on Corning glass, ITO coated glass, and Quartz glass. The nonlinear optical attributes comprising the third-order nonlinear optical susceptibility and

nonlinear refractive index have been estimated using theoretically via Generalized Miller's Rule and the obtained values have been compared with the values reported in literature. Lastly, heterostructures of PZT and ZnO synthesized via sol-gel technique and deposited via spin-coating method on Corning and ITO coated glass have been studied with special focus on their linear and nonlinear optical properties. The nonlinear optical attributes comprising the third-order nonlinear optical susceptibility and nonlinear refractive index have been estimated using theoretically via Generalized Miller's Rule and the obtained values have been compared with the values reported in literature.