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Effect of Oxygen Ion Irradiation on the Structural, Spectral and Optical Properties of L-Arginine Acetate Single Crystals

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Abstract : Ion beams play a significant role in the process of tuning the properties of materials. Based on the radiation behavior, the engineering materials are categorized into two different types. The first one comprises organic solids which are sensitive to the energy deposited in their electronic system and the second one comprises metals which are insensitive to the energy deposited in their electronic system. However, exposure to swift heavy ions alters this general behavior. Depending on the mass, kinetic energy and nuclear charge, an ion can produce modifications within a thin surface layer or it can penetrate deeply to produce long and narrow distorted area along its path. When a high energetic ion beam impinges on a material, it causes two different types of changes in the material due to the columbic interaction between the target atom and the energetic ion beam: (i) inelastic collisions of the energetic ion with the atomic electrons of the material; and (ii) elastic scattering from the nuclei of the atoms of the material, which is extremely responsible for relocating the atoms of matter from their lattice position. The exposure of the heavy ions renders the material return to equilibrium state during which the material undergoes surface and bulk modifications which depends on the mass of the projectile ion, physical properties of the target material, its energy, and beam dimension. It is well established that electronic stopping power plays a major role in the defect creation mechanism provided it exceeds a threshold which strongly depends on the nature of the target material. There are reports available on heavy ion irradiation especially on crystalline materials to tune their physical and chemical properties. L-Arginine Acetate [LAA] is a potential semi-organic nonlinear optical crystal and its optical, mechanical and thermal properties have already been reported The main objective of the present work is to enhance or tune the structural and optical properties of LAA single crystals by heavy ion irradiation. In the present study, a potential nonlinear optical single crystal, L-arginine acetate (LAA) was grown by slow evaporation solution growth technique. The grown LAA single crystal was irradiated with oxygen ions at the dose rate of 600 krad and 1M rad in order to tune the structural and optical properties. The structural properties of pristine and oxygen ions irradiated LAA single crystals were studied using Powder X- ray diffraction and Fourier Transform Infrared spectral studies which reveal the structural changes that are generated due to irradiation. Optical behavior of pristine and oxygen ions irradiated crystals is studied by UV-Vis-NIR and photoluminescence analyses. From this investigation we can concluded that oxygen ions irradiation modifies the structural and optical properties of LAA single crystals.

Keywords : heavy ion irradiation, NLO single crystal, photoluminescence, X-ray diffractometer
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