ABSTRACT

Crystal growth and characterization is a vital and fundamental part in the field of surface physics, crystallography, material science and engineering. Crystals of good quality and perfection are required for practical devices such as detectors, transducers, solid state lasers, frequency converters, and for other millions and millions of applications. Hence many new crystals had to be grown to evaluate their device properties. The development of scientific instruments and analytical methods makes it possible to understand the optical, thermal, mechanical, and other properties of crystals.

The technological developments depend critically on the availability of suitable single crystals. The application of semiconductor based electronics creates a demand for high quality ferroelectric, piezoelectric, and optical single crystals. After the introduction of nonlinear optics, the nonlinear effects are used as scientific tools to investigate physical and chemical process in atoms, molecules, crystals, thin films, and polymers that are promising for commercial device applications. The importance of NLO phenomena leads to the development of nonlinear optical materials. To date these materials are utilized in information processing, optical switching, frequency conversion, telecommunication and optotechnology. Hence the search and growth of new nonlinear optical materials having novel properties is an indispensable area of research.
Thiourea cadmium-zinc sulphate (CZTS), a semi-organic nonlinear optical material was grown by slow evaporation technique. Solubility of the synthesized material has been determined for various temperatures using water as solvent. Single crystal X-ray diffraction studies shows thiourea cadmium-zinc sulphate belongs to triclinic system. The crystalline nature of the grown crystal was confirmed by powder X-ray diffraction and the diffraction peaks were indexed for the lattice parameters $a = 8.7385 \, \text{Å}$, $b = 9.0547 \, \text{Å}$, $c = 9.7478 \, \text{Å}$. The optical absorption studies reveal that the lower cut-off wavelength was observed at 380 nm. Thermal analysis shows that the compound can be exploited for application below 363 K. The surface morphology and facets of the as grown crystal were studied by contact goniometry. The SHG relative efficiency of thiourea cadmium-zinc sulphate crystal was found to be 1.8 times higher than that of KDP.

Good quality single crystal of 2-Aminopyridinium maleate (2-APM) was grown by solvent evaporation method at room temperature. 2-Aminopyridinium maleate crystallizes in the monoclinic system. The surface morphology reveals that for each face, their parallel friedel planes also present in the grown crystal. Thermal studies show that the material is stable up to 422 K. The laser second harmonic generation intensity of 2-Aminopyridinium maleate crystal was found to be 1.5 times higher than that of the reference KDP sample.
Single crystal of Tris thiourea glycine (TTG) an organic nonlinear optical material was grown from aqua solution by slow evaporation method at room temperature. It was found that the crystal belongs to monoclinic system. Differential thermal and thermo gravimetric analysis reveals that the crystal is stable up to 437.8 K. From the hardness measurement, the crystal is mechanically stable up to 100 g. The SHG efficiency of tris thiourea glycine was found to be 0.8 times that of KDP crystal.

2-Aminopyridinium benzoate (2-APB) an organic nonlinear optical material have been synthesized and grown by slow cooling technique. The morphology studies indicate that the (001) plane is the most prominent plane among the other well developed planes. The absorption spectrum shows a lower UV cutoff wavelength at 330 nm. TGA-DTA studies reveal that the material is stable up to 428.8 K. Dielectric studies reveal that both dielectric constant and dielectric loss decreases with increase in frequency. The second harmonic generation intensity of 2-Aminopyridinium benzoate crystal was found to be 1.8 times higher than that of KDP reference material.

Single crystals of benzimidazolium perchlorate (BPC) a novel organic nonlinear optical material were grown by slow evaporation solution growth technique. The grown crystal belongs to orthorhombic system. The absorption spectrum shows a lower UV cutoff wavelength at 360 nm. The stochiometry of the crystal was confirmed by elemental CHN analysis. The
second harmonic generation (SHG) efficiency of benzimidazolium perchlorate was found to be 1.2 times higher than KDP which makes it a promising material for NLO applications.

An organic nonlinear optical material Benzoyl Glycine (BG) was grown in a mixed solvent of N, N-Dimethyl Formamide and water by slow cooling technique. It was found that the crystal belongs to orthorhombic system and crystallizes in the non centro symmetric space group P2_12_1. UV-Vis-NIR absorption spectrum shows lower cut off at 340 nm. The powder SHG efficiency of Benzoyl Glycine was 2.5 times higher than that of KDP.