CHAPTER 8

SUMMARY AND SUGGESTIONS FOR FUTURE WORK

8.1 SUMMARY

The solution growth is a simple process, which yields crystals with less defects. The development in modern technologies such as optical information processing, optical data storage, optical computing, IR detectors, etc. depend on the crystals grown by aqueous solution. The increasing demands for nonlinear optical crystals are due to their frequency conversion and the growth of bulk NLO crystals becomes inevitable. In the present thesis, the growth of a semiorganic nonlinear optical crystal Thiourea cadmium–zinc sulphate (CZTS), and organic nonlinear optical crystals 2- Aminopyridinium maleate (2-APM), Tris Thiourea Glycine (TTG), 2- Aminopyridinium Benzoate (2-APB), Benzimidazolium Perchlorate (BDP) and Benzoyl Glycine crystal (BG) and their characterization studies are reported.

The nonlinear optical crystals such as Thiourea cadmium–zinc sulphate (CZTS), 2-Aminopyridinium maleate (2-APM), Tris thiourea glycine (TTG), 2-Aminopyridinium benzoate (2-APB), Benzimidazolium Perchlorate (BDP), Benzoyl glycine crystal (BG) have been grown by low temperature solution growth technique. The grown crystals were characterized by x-ray diffraction, Fourier transform infrared spectroscopy, optical absorption, thermal, dielectric, micro hardness, morphology, etching, CHN test and second harmonic generation efficiency studies.
Semi-organic nonlinear optical crystals of thiourea cadmium-zinc sulphate (CZTS), has been grown by slow evaporation solution growth technique at room temperature. The solubility studies were performed at various temperatures. X-ray diffraction shows that CZTS belongs to triclinic system. The functional groups present in the compound were analyzed by FTIR spectrum. DTA and TGA analysis reveals that the melting point of the crystal is 363 K. Morphology studies shows that the (001) plane is the most prominent one among the other developed planes. Micro hardness reveals that the crystal is mechanically stable up to 90 g. Etching studies shows that the crystal grows by two dimensional layer growth mechanism. The SHG relative efficiency of thiourea cadmium-zinc sulphate crystal was found to be 1.8 times higher than that of KDP.

Optically transparent single crystals of 2-Aminopyridinium maleate were grown by solvent evaporation technique in aqueous solution at room temperature. 2-APM belongs to monoclinic system with non-centrosymmetric space group P2c and the cell parameters are \(a = 9.281 \ \text{Å}, \ b = 4.905 \ \text{Å}, \ c = 11.163 \ \text{Å}\). The TGA-DTA traces confirm that the crystal is thermally stable up to 422 K. The formation of 2-Aminopyridinium maleate was confirmed by CHN analysis. The second harmonic generation intensity of 2-Aminopyridinium maleate crystal was found to be 1.5 times higher than that of KDP.

Single crystals of tris thiourea glycine were grown by slow evaporation technique. TTG belongs to monoclinic system. The crystal is transparent in the entire visible region. The functional groups were confirmed by FTIR analysis. DTA, TGA analysis reveals that the melting point of the crystal is 466.1 K. From the hardness measurement, the crystal is mechanically stable up to 110 g. The powder SHG efficiency of tris thiourea glycine is 0.8 times that of KDP.
2-Aminopyridinium benzoate a non linear optical crystal was grown by slow cooling technique. Morphology indicates that the growth rate along a direction is faster than the growth along other directions. Thermal studies confirm that the crystal is thermally stable up to 428.8 K. The dielectric constant is relatively high at low frequency region. The SHG efficiency of 2-Aminopyridinium benzoate was 1.8 is comparable with that of 2-Aminopyridinium maleate.

Single crystals of benzimidazolium perchlorate were grown by slow evaporation technique. Solubility curve shows that the material has high solubility. Induction period was determined for different temperatures and is found to decrease with the increase of temperature. X-ray diffraction study confirms that the BDP crystal belongs to orthorhombic system. The material is thermally stable up to 406.9 K. The CHN analysis confirms the formation of BDP. The second harmonic generation efficiency of BDP crystal was found to be 1.2 times higher than that of KDP.

Good quality single crystal of Benzoyl Glycine was grown by slow cooling technique. X-ray diffraction studies reveal that BG belongs to orthorhombic system. The functional groups present in the grown crystals were confirmed by FTIR spectral analysis. Micro hardness reveals that the hardness increases with increase of load. The SHG efficiency of crystal was found to be 2.5 times higher than that of KDP reference material. The crystal can be used for NLO applications up to 447 K.

8.2 SUGGESTIONS FOR FUTURE WORK

The growth and characterization of 2-Aminopyridinium maleate and 2-Aminopyridinium benzoate were carried out. The SHG efficiency of these
two crystals is almost same. 2-Aminopyridine complex crystals are highly
needed for optical and optoelectronic applications as they have wide
transparency in the visible region. Hence attempts can be made to grow
crystals of other 2-Aminopyridine compounds.

Benzoyl Glycine is a potential material for NLO applications. The
SHG efficiency of Benzoyl glycine was 2.5 times higher than that of KDP.
Attempts can be made to grow organics doped benzoyl glycine crystals to
improve the SHG efficiency.