7. SUMMARY AND SUGGESTIONS FOR FUTURE WORK

7.1 SUMMARY

Non linear optics (NLO) is one of the leading scientific branches of research. Identifying and understanding the new physical phenomenon of the NLO materials as well as finding its application in industries are of great interest now. NLO materials are now widely used in data storage, optical communications, medical diagnostics, signal processing and optical switching. All the above applications depend upon a variety of properties of the materials, like transparency, SHG efficiency, hardness, dielectric constant and thermal stability.

The present investigation deals with the growth of single crystals of 6-methyl-nicotinic acid (6MNA), ammonium citrate dibasic (ACD), O-acetyl mandelic acid (AMA), and 3,4 diaminonitrobenzene (DANB) by the slow evaporation technique. The grown crystals have been subjected to single crystal XRD, powder XRD, FTIR, NMR and optical transmission analysis. Thermal stability, hardness test, dielectric properties and NLO studies have also been done for the grown crystals.

Single crystal X-ray diffraction analysis confirmed the crystal systems along with its space group. The crystallinity of the grown crystals was confirmed by powder X-ray diffraction analysis. The various functional groups present in the crystals have been confirmed by FTIR and NMR studies. Maximum transmittance in the entire visible region of the electromagnetic spectrum was confirmed by the UV-Vis-NIR spectra .

The thermal property of 6MNA, ACD, AMA and DANB single crystals were investigated. TGA and DTA studies were done to understand the thermal properties of the grown crystals. The grown crystals have good thermal stability. The 6MNA and

DANB crystals have high decomposition temperature of 213°C and 205°C respectively and they do not undergo phase transition up to this temperature.

Mechanical stability of organic single crystals play a vital role in device fabrication. Vicker's microhardness studies were carried out for the grown crystals with flat and smooth faces for different applied load. Vicker's microhardness number H_V was also computed. The crystals were found to withstand up to the load of 50 g and above 50 g cracks were developed on the surface of the crystals. Hardness of 6MNA and ACD crystals increases with the load. This confirms that the intrinsic strength of the chemical bonds is high in these two cases.

The dielectric constant and dielectric loss variation were measured as a function of different frequencies for the grown crystals. Non linear optical behaviors of the grown crystals were studied using Kurtz Perry powder technique. The second harmonic efficiency was compared with the standard compound potassium dihydrogen phosphate (KDP).

- Materials to be used for second order NLO application must have noncentrosymmetric orientation. All the grown materials were confirmed to be noncentrosymmetric from the single crystal X-ray diffraction studies
- From the UV-Vis-NIR spectra it is observed that all the crystals are completely transparent in the entire visible region. This is a good enough criteria for producing SHG
- Thermal stability of 6MNA is found to be 213^0C and DANB is stable upto 205°C, whereas ACD and AMA are stable up to 197.27^0C and 148^0C respectively

- From the hardness studies it is found that 6MNA and ACD belong to soft category materials and AMA, DANB are hard category materials
- Dielectric constant and dielectric loss of all the crystal are low at high frequency region reveals the high optical quality of the crystal with lesser defects, which is the desirable property for NLO applications
- Among the four nonlinear optical single crystals investigated in the present research work, (ACD) ammonium citrate dibase (2.5 times greater than KDP) and (AMA) acetyl mandelic acid (2.3 times greater than KDP) have slightly higher SHG efficiency than the other two. This may be due the transparency of these materials. But all the grown materials have sufficient SHG efficiency to be used in optical devices

7.2 SUGGESTIONS FOR FUTURE WORK

- ✓ The growth of single crystals of 6MNA, ACD, AMA and DANB has been carried out by slow evaporation technique. By adopting Sankaranarayanan-Ramasamy method crystals with necessary orientation can be grown and hence the optical quality of the crystals could be improved
- ✓ The effect of adding impurities in different ratios on these crystals can be studied
- ✓ As the pH value and the choice of the solvent influence the SHG efficiency of the crystals, these parameter can included for further studies
- ✓ The grown crystals can be characterized using advanced microscopic techniques like AFM, SEM and TEM
- ✓ Laser damage threshold study and Z scan measurement can be done for all the grown NLO materials

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