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Investigation on growth, thermal, SEM and SHG studies of novel semi organic NLO crystals

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ABSTRACT

The single crystals of 2-amino hexanoic acid zinc sulphate (2AHAZS) have been grown by solution growth using slow evaporation technique. SEM analysis showed the surface morphology of the sample. The EDAX analysis showed the grown compound elements. The thermal stability of the crystal was determined from thermo gravimetric and differential thermal analysis curve. The second harmonic generation behaviour of 2AHAZS crystal was tested by Kurtz-Perry powder technique. This single novel semiorganic crystals of 2AHAZS showed high thermal stability and large non-linearity nature.

KEY WORDS: Nonlinear Optical, 2-amino hexanoic acid zinc sulphate, Second Harmonic Generation, Thermo Gravimetric Analysis, Differential Thermal Analysis.

1. INTRODUCTION

Semi-organic materials have good polarizability, low disband nature and high damage threshold. By and large, NLO material has emerged its application in data storage, frequency conversion and other optical switching purposes. 2-amino hexanoic acid zinc sulphate crystals (2AHAZS) a semi organic material has been synthesized by slow evaporation method. Crystals have been grown at room temperature. The thermal behaviour has been investigated by thermogravimetric (TGA) and differential thermogram analysis (DTA). SEM investigations showed the quality of the grown crystals. The non-linearity nature has been investigated by SHG studies using Kurtz-Perry technique.

2. EXPERIMENTAL

High purity salts (99.9%) were used for the crystal growth. Single crystals of 2-amino hexanoic acid zinc sulphate (2AHAZS) were grown at room temperature by solution growth using slow evaporation method, of an aqueous solution containing zinc sulphate and 2-amino hexanoic acid in equal stoichiometric ratio as per the reaction. The temperature of water in the bath was controlled digitally by using microprocessor. Variation in temperature of the bath can be tuned to an accuracy of ±0.1°C. Optically good quality crystals of the title compound were harvested in span of 20 days. The photograph of the 2AHAZS crystal is shown in fig.1.

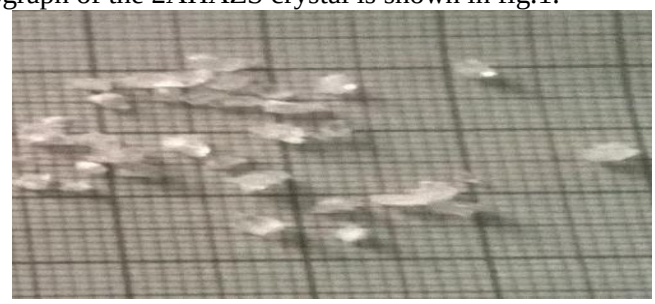

Fig.1. Photograph of the grown 2AHAZS crystals

2.1. Characterization: Thermal behavior of the grown sample was studied using instrument NETZSCH STA 449F3 thermal analyzer. The surface morphology and elemental analysis were studied using TESCAN SEM-VEGA III and CONTEXT software respectively. The NLO property of 2AHAZS crystal was tested by Kurtz powder SHG (Second Harmonic Generation) test using Nd:YAG laser(1064nm).

3. RESULTS AND DISCUSSION

3.1. Thermal studies: The thermal characteristics of 2AHAZS, differential thermal analysis (DTA) and thermo gravimetric analysis (TGA) were carried out by the instrument NETZSCH STA 449F3 simultaneously. The sample was heated at a rate of 20˚C/min in the region 0˚C to 1000˚C to testify the weight loss and thermal stability. Fig.2 shows the thermo grams illustrating simultaneously recorded TGA and DTA. The decomposition starts, where the endothermic transition occurs at 250˚C. The material is fully decomposed above 300˚C. The weight loss curve is very sharp and it starts at 250˚C. This weight loss is due to the liberation of volatile substances. The sharpness of the endothermic peak shows good degree of crystallinity of the grown crystal. The peak at 325˚C indicates a phase transition as an evidence from the loss of weight in the TG curve.

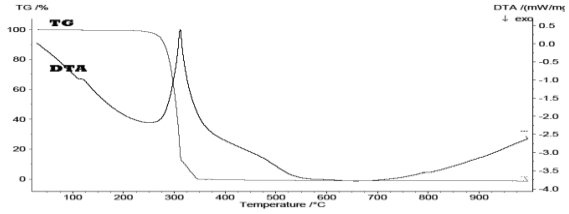

Fig.2.TG-DTA curve of 2AHAZS

3.2. Surface morphology studies and Elemental analysis: Fig.3 (a&b) shows the scanning electron micrographs of 2AHAZS crystals using TESCAN SEM. The image implies a mixed dense and columnar structure. The SEM annotations show a jagged structure on the top layer with fine patterns. At higher magnification it is observed as the bulk growth. Fig.4 showed the elements present in the title compound. The presence of C, N, Zn, S, O peaks in EDAX spectrum established the presence of grown 2-amino hexanoic acid zinc sulphate.

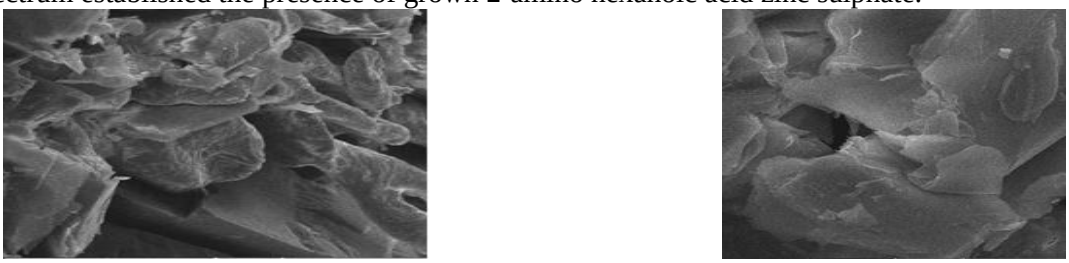

Fig.3.SEM images of 2AHAZS crystals

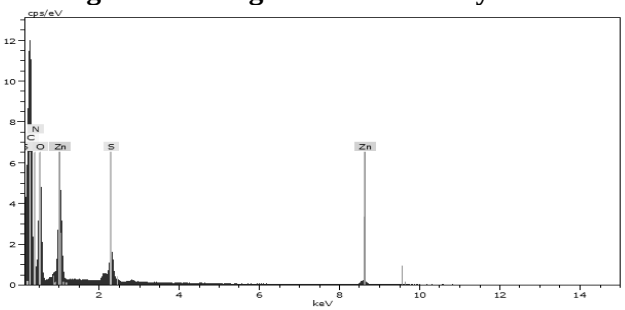

Fig.4. EDAX image of 2AHAZS

3.3. NLO studies: The second harmonic generation SHG test on the 2AHAZS crystal was performed by Kurtz powder SHG method. The powdered sample of 2AHAZS crystal was illuminated using the fundamental beam of 1064 nm from Q-switched Nd:YAG laser. The input energy incident on the sample was 0.68J. The output energy of the sample was 18.7 mJ. The KDP reference energy is 8.8 mJ. Hence, the title compound has good nonlinearity.

4. CONCLUSION

Single crystals of 2-amino hexanoic acid zinc sulphate a new semi organic NLO material have been grown from aqueous solution. The element analysis showed the presence of zinc, sulphur, nitrogen, oxygen, and carbon atoms. The purity of the crystal is confirmed from the sharpness of the endothermic peaks. The SHG confirmed the NLO property of the crystal. Thus, 2AHAZS crystals have high thermal stability and large non-linearity nature.

5. ACKNOWLEDGEMENTS

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