Asian Journal of Chemistry Vol. 21, No. 5 (2009), 3459-3462

Growth and Characterization of Glycine Sodium Nitrate as Laser Based Non-Linear Optical Material

S. PALANISWAMY* and O.N. BALASUNDARAM
Department of Physics, PSG College of Arts & Science, Coimbatore-641 014, India

Single crystals of glycine sodium nitrate (GSN), a semi organic non-linear optical material has been grown from solution by slow evaporation at ambient temperature. The growth of crystals has been observed at various pH values. The chemical composition of the grown crystals was determined by FTIR spectra. The crystalline nature and its various planes of reflection were observed by powder XRD. The second harmonic generation was also confirmed using Nd:YAG laser.

Key Words: Semi organic, Slow evaporation, Non-linear optical.

INTRODUCTION

Non-linear optical (NLO) materials play a major role in non-linear optics in electro optical modulators, high density optical memories, colour displays in the realization of signal processing devices involving the generation of new frequencies, signal amplifications, emissions or oscillation *etc.*[1,2]. Non-linear optical property materials play an important role in the field of fibre optic communications[3].

Some materials change the frequency of incident monochromatic light when it passing through them. Light of (red light) lower range of frequency when passed (blue or green light), higher range of frequency is obtained. The important non-linear optical materials from the device point of view are generally in the form of single crystals and must meet a wide variety of ancillary material requirements for optical use. In general, they will require extra ordinary stability with regard to ambient conditions and high intensity light sources.

EXPERIMENTAL

Glycine sodium nitrate (GSN) was synthesized from 1:1 ratio of glycine (99 % pure, Merck) and sodium nitrate (99 % Pure, Merck).

$$NH_2CH_2COOH + NaNO_3 \rightarrow NH_2\,NO_3CH_2COONa$$

The experiment was carried out in room temperature. Solution was prepared using sodium nitrate and glycine. The pH was adjusted to 6 by adding 2 or 3 drops of dilute nitric acid, after attaining super saturation. Number of thin seed crystals was obtained after a week. The purity of the crystal was improved by successive re-crystallization process. These seed crystals were used for the growth of bulk glycine sodium nitrate crystals.

Growth of bulk crystals of γ-glycine at ambient temperature has been reported[4]. In present investigation, the growth of GSN crystals by solution growth technique and its characterization by using XRD, FTIR and UV-Visible spectra analyses are reported.

RESULTS AND DISCUSSION

The melting point of the grown crystals was found using melting point apparatus. The micro-capillary tube containing the powder sample was inserted into the melting point apparatus with a thermometer nearby. The temperature was gradually increased and the powder started to change brown in colour at 205 °C and sintered at 239 °C. The error in the measurement was ± 1 °C.

The grown crystals have been characterized by powder X-ray diffractometer. Fig. 1 represents the powder X-ray pattern of the grown glycine sodium nitrate. The lattice parameter values of glycine sodium nitrate taken from the literature were used for the simulation of hkl values and corresponding d-values have been calculated. The single crystal X-ray diffraction analysis has been performed using the single crystal X-ray diffractometer on glycine sodium nitrate crystals and was found to be monoclinic.

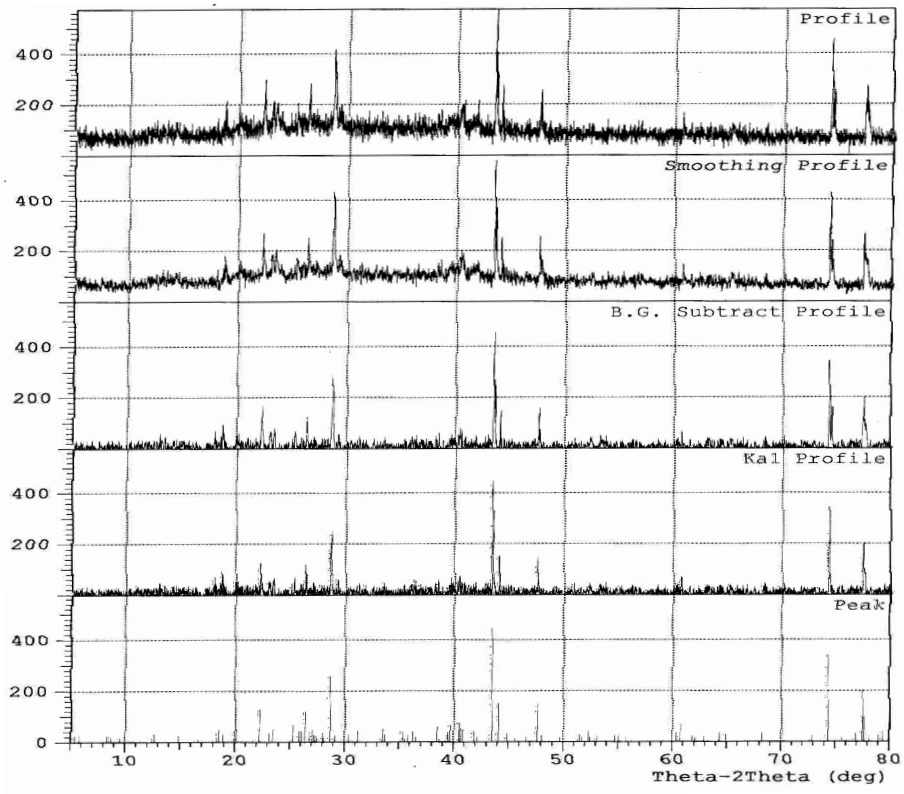

Fig. 1.

The FT-IR spectrum of glycine sodium nitrate was recorded using FTIR spectrometer in the region 4000-400 cm^{-1}. Amino acids in the form of Zwitter ions[6] do not show N-H stretching at 3200 cm^{-1} but show a broad band between 3130 cm^{-1} assigned to asymmetric stretching of NH_3 group. Absorption depends upon the structure of amino acids. Hydrochlorides of amino acids containing NH_3 group absorb between 3145 and 3050 cm^{-1} in Zwitter ions, two vibrational modes of the carboxylate ion are readily identified between 1600-1410 cm^{-1}. The asymmetric vibrational band at 1600-1560 cm^{-1} is broad and strong. In hydro-chlorides of amino acids, the C=O absorptions are shifted to higher frequencies. In the hydrochloride of α-amino acid, C=O stretching occurs at 1754-1724 cm^{-1}. This higher frequency absorption is due to the negative inductive effect of NH_3 group. When NH_3 group is present in the more remote position, *e.g.*, in δ-amino valeric acid, C=O stretching returns to 1710 cm^{-1}. N-H deformation bands occur near 1600 cm^{-1}. Frequency assignment is given in Table-1.

TABLE-1
FREQUENCY (cm^{-1}) ASSIGNMENT FOR GLYCINE SODIUM NITRATE

Frequency	Assignment	Frequency	Assignment
3250s	O-H bond	1508m	N-H (2-amide) ‖ bond
3024m	=C-H & $=CH_2$	1368m	CH_3 deformation
2963s	O-H (broad)	1039s	O-C
2744m	-C-H (aldehyde C-H)	914s	=C-H & $=CH_2$
2274m	-N=C=O, -N=C=N-	698m	*cis*–RCH=CHR
1585m	N-H (1-amide) ‖ bond	–	–

The non-linear optical (NLO) property of the grown crystal has been tested using Nd:YAG laser. A small crystal sample was placed on the sample holder and purple red colour laser beam (1064 nm) was made to pass through the crystal and the incoming beam passing through the crystal and the outgoing beam was observed to be green light (530 nm) (Table-2).

TABLE-2
NON-LINEAR OPTICAL TEST

Frequency of input laser beam (nm)	Frequency of output laser beam (nm)
1064	532

The UV-visible spectrum of glycine sodium nitrate crystals was recorded using an UV-visible spectrophotometer. The transparent behaviour of glycine sodium nitrate in the entire UV visible region is clearly illustrated by its UV-visible spectrum shown in Fig. 2. The major observations are seen from thespectrum: (i) At 337 nm there is a steep increase of transmission coefficient from 0 to 50 %. (ii) At 852 nm there is a steep increase of transmission from 50 to 80 %. (iii) From 852 to 1441 nm the transmission is almost constant.

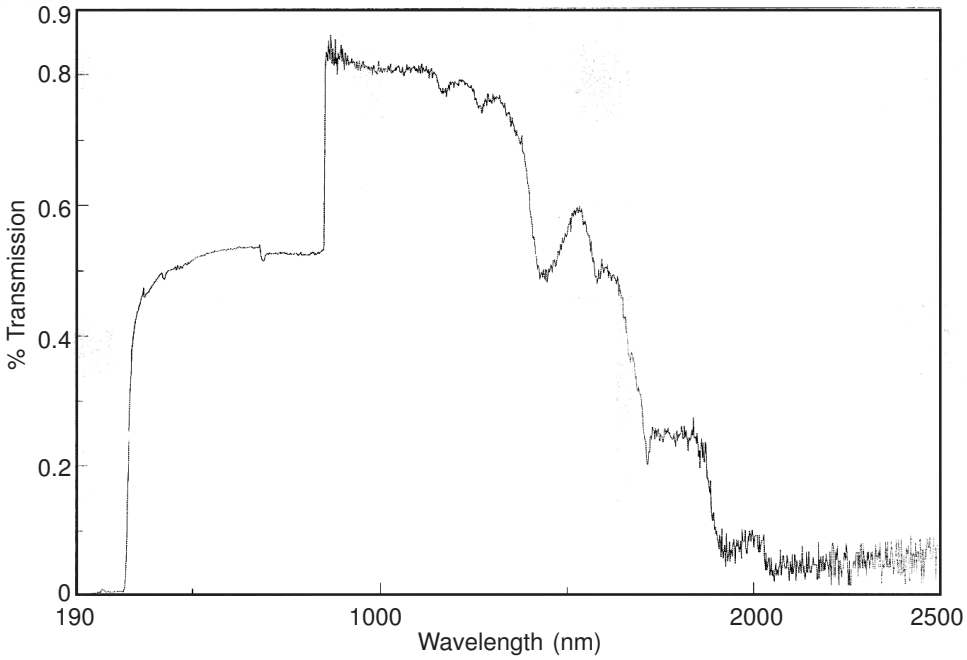

Fig. 2

Conclusion

From the following studies, it is clear that glycine sodium nitrate is crystalline and having the NLO property. This crystal is formed by the zwitter ions mixing with the sodium ion and the nitrate ion. (NH_2 NO_3CH_2COONa). Ammonium cation coupling with nitrate anion and the acetate anion with sodium cation, is confirmed through FTIR.

ACKNOWLEDGEMENT

This research work is supported by University Grants Commission, Minor Project File No.MRP-750/05(UGC-SERC) Link No.1750.0.

REFERENCES

1. D.S. Chemla and J. Zyss, Non-linear Optical Properties of Organic Molecules and Crystals, Academic Press, New York, Vols. 1 and 2 (1987).
2. N.J. Long, *Angew. Chem.*, **31**, 21 (1995).
3. R.F. Belt, G. Gashurov and Y.S. Liu, *Laser Focus*, **10**, 110 (1995).
4. M.N. Bhat and S.M. Dharmaprakash, *J. Cryst. Growth*, **236**, 376 (2002).
5. B.C. Gilbert, Investigation of Molecular Structure, Bell & Hyman Limited, London.
6. L.G. Wade, Organic Chemistry, Pearson Education Australia, edn. 4 (2006).

(*Received*: 18 April 2008; *Accepted*: 5 February 2009) AJC-7212