



## SYNTHESIS GROWTH AND CHARACTERIZATION OF STRONTIUM CHLORIDE DOPED L-VALINE CADMIUM CHLORIDE CRYSTALS GROWN BY SLOW EVAPORATION TECHNIQUE

<sup>1</sup>R.Sajitha, <sup>2</sup>Dr.S.Dawn Dharma Roy

<sup>1,2</sup>Department of Physics, N. M. Christian College, Marthandam, Tamil Nadu, India.

**ABSTRACT:-** A new semi organic non- linear optical material, L-valine cadmium chloride (LVCC crystal) doped with strontium chloride has been grown successfully by slow evaporation technique. The grown crystal was characterized by using powder X- ray analysis and confirmed the identity of the title compound. The presence of functional groups of the grown crystal has been confirmed by Fourier Transform Infrared Spectroscopy (FTIR) analysis. TGA/DTA studies revealed the thermal stability and the mechanical strength of grown crystals. The optical absorption study was examined by UV-VIS spectrum.

**Keywords:** Slow evaporation method, XRD, FTIR, UV spectrum, Thermal studies.

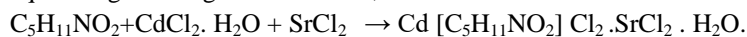
### INTRODUCTION

Growth of Non Linear Optical (NLO) single crystals with good quality initiates the development of many novel devices in the field of optoelectronics and optical communication such as optical modulator, optical data storage and optical switches [1-4]. Semi Organic NLO materials are generally have a high nonlinear coefficient, high laser damage threshold, high thermal stability and mechanical strength than inorganic crystals [5-6]. In this connection, amino acids are prominent materials for NLO applications, as they contain zwitterions, which create the hydrogen bonds used for the generation of non centro symmetry structures favorable for attractive SHG properties of crystal [7-9]. Except Glycine, generally amino acids having a Proton donating carboxyl group (Coo<sup>-</sup>) and a proton accepting amino (NH<sub>3</sub><sup>+</sup>) group, having a tendency of combining with that of inorganic salt [10]. As a result good NLO crystals such as L-Valine hydro bromide [11], L-Valine cadmium acetate [12], L-Valine Potassium Chloride [13], L-valine Zinc Sulphate [14-15], L-Valine Nickel Chloride [16], L-Valine Succinate [17], L-Valine Oxalate [18], L-Valine hydro Chloride [19], L-Valine hydro bromide [20], L-Valine Cadmium bromide [21], L-Valine Cadmium Chloride [22] has been grown and its characterization studies have been already reported.

In this present investigation, L-Valine Cadmium Chloride Crystal (LVCC) doped with strontium chloride has been grown from its aqueous solution by slow evaporation method. Attempt has been made to characterize the crystals through the techniques such as powder XRD, FTIR, TGA/DTA and UV-Visible.

### Crystal Growth

L-Valine and Cadmium Chloride has been taken in an equimolar ratio of 1:1 and was dissolved in deionized water. 1M of strontium chloride has been added slowly. The solution was stirred continuously using a magnetic stirrer for six hours to yield a homogeneous mixture. The prepared solution was filtered and kept undisturbed at room temperature. Tiny seed crystals with good transparency were obtained due to spontaneous nucleation after a period of fifteen days. The chemical equation governing the reaction is,



The photograph of the grown LVCC crystal doped with strontium chloride is shown in fig.1

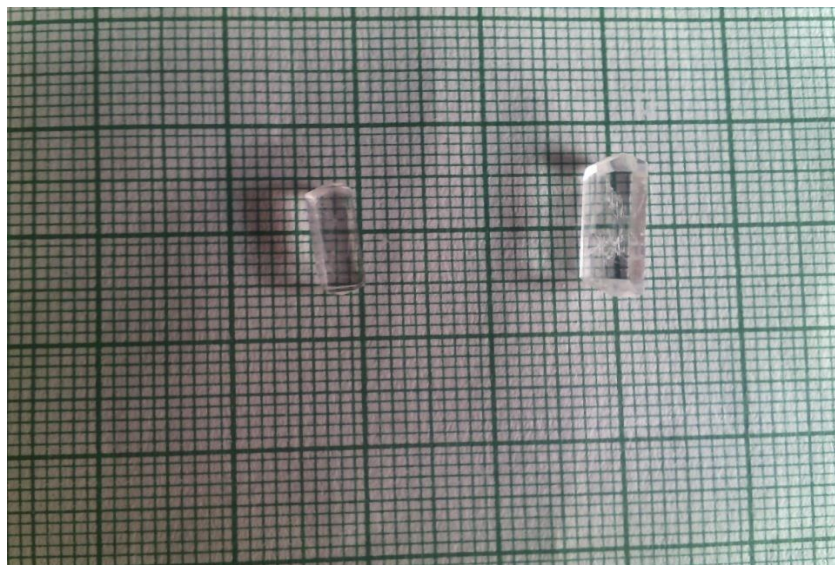


Fig. 1 The Photograph of LVCC Crystal doped with Strontium Chloride

### EXPERIMENTAL DETAILS

The LVCC crystal doped with strontium chloride was subjected to powder X-ray diffraction studies. Powder X-ray diffraction pattern was undertaken by X-ray diffraction meter (Model JDX 8030) with  $\text{CuK}\alpha$  ( $\lambda = 1.5418\text{\AA}$ ). The compositional analysis of the grown LVCC crystal doped with strontium chloride was made quantitatively using energy dispersive X-ray analysis. The presence of functional groups has been confirmed with the help of Perkin Elmer FTIR spectrometer in the range of  $400$  to  $4000\text{ cm}^{-1}$  using KBr pellet technique. The optical transmission spectrum of LVCC crystal doped with strontium chloride was investigated by  $\lambda 35$  model Perkin Elmer double beam uv-visible spectrometer in the range of  $190\text{nm}$  to  $1100\text{nm}$ . The nonlinear optical property was confirmed by illuminating the sample by using Nd: YAG laser ( $\lambda = 1064\text{ nm}$ ).

### RESULTS AND DISCUSSIONS

#### Powder XRD Analysis

The powder XRD pattern of LVCC crystals doped with strontium chloride is shown in fig.2. The sharp and sensitive peaks confirmed the crystalline nature of the grown crystal. The highest intense peaks of the observed powder XRD pattern has been compared with the standard XRD pattern of L-Valine (JCPDS file no.33-1954) and is indexed.

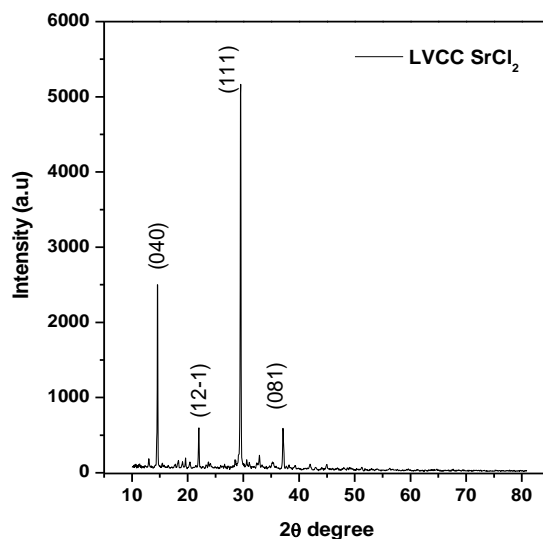
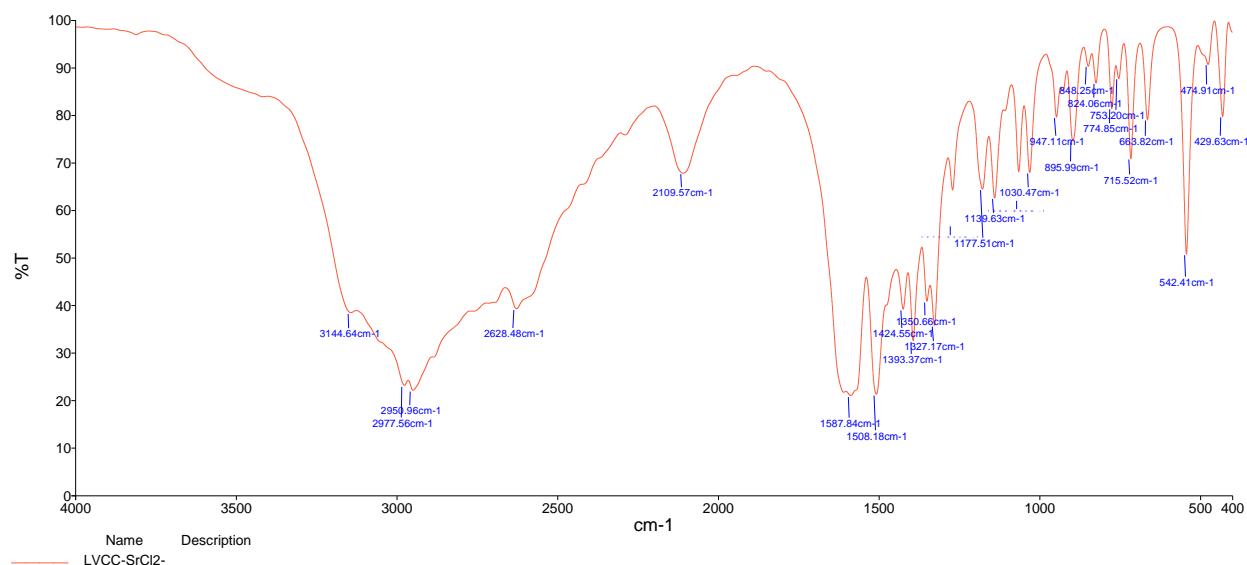


Fig.2 The powder XRD pattern of the grown LVCC crystal doped with strontium chloride FTIR Analysis

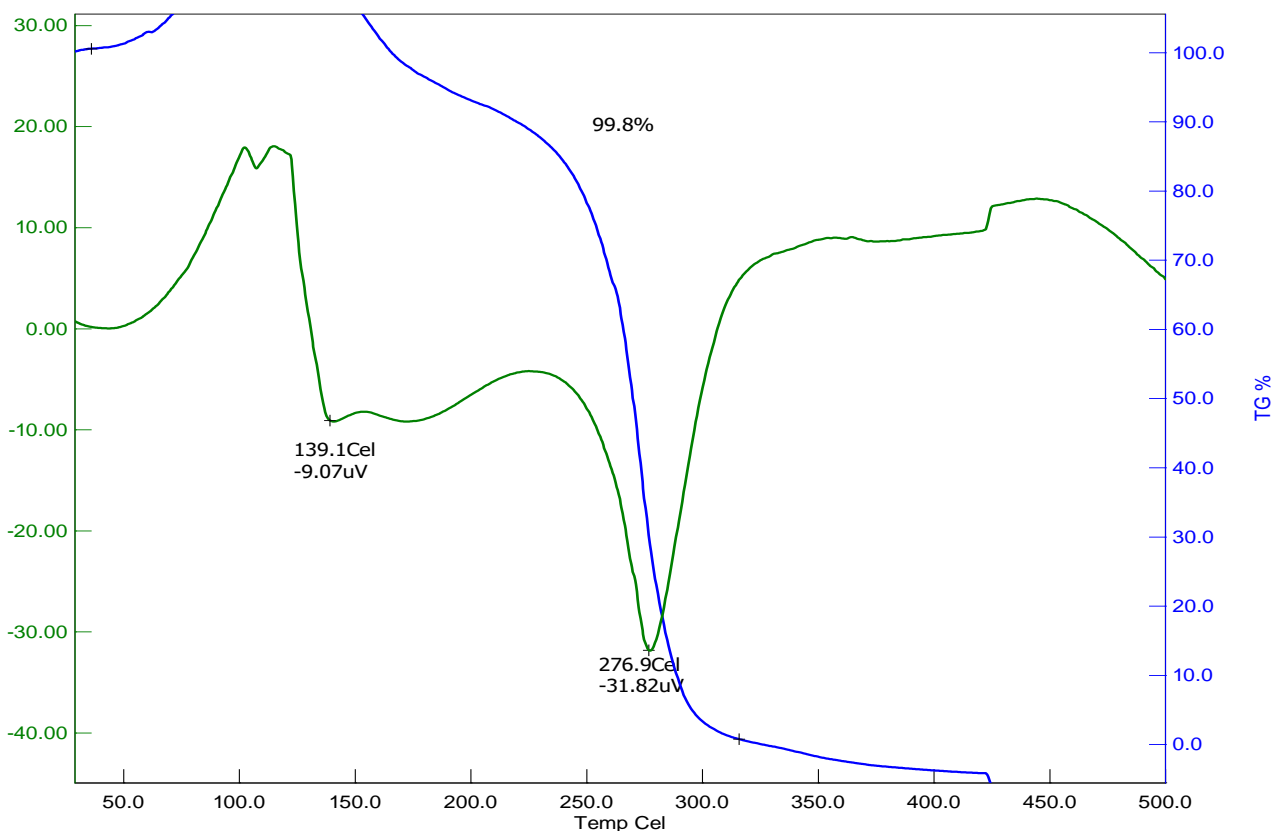
The FTIR spectrum of LVCC crystal doped with strontium chloride is presented in fig.3. In the spectrum the narrow envelope found at  $3145\text{ cm}^{-1}$  is due to  $\text{NH}_3^+$  asymmetric stretching vibrations. The medium peak observed at  $2978\text{ cm}^{-1}$  is assigned to  $\text{NH}_2^+$  symmetric stretching vibrations. The peak occurs at  $2628\text{ cm}^{-1}$  is associated with N-H-O valence stretching combination. The narrow peak at  $2110\text{ cm}^{-1}$  may be due to C-O-C stretching vibration. The strong peak at  $1588\text{ cm}^{-1}$  is attributed to  $\text{COO}^-$  asymmetric stretching vibration.  $\text{NH}_3^+$  symmetric deformation have been observed at  $1508\text{ cm}^{-1}$ . The weak bands at  $1425$  and  $1393\text{ cm}^{-1}$  are correlated to bending vibration of  $\text{CH}_2$  and  $\text{COO}^-$  symmetric stretching vibration respectively. The C-O stretching components are observed at  $1351$  and  $1327\text{ cm}^{-1}$ . C-C stretching mode vibrations appear at  $1178$  and  $1140\text{ cm}^{-1}$ . The band occur at  $947\text{ cm}^{-1}$  confirm the rocking vibration of  $\text{CH}_2$ . The peaks at  $896$  and  $848\text{ cm}^{-1}$  are owing to the rocking vibration of  $\text{NH}_3^+$ . The peaks seen at  $824$  and  $716\text{ cm}^{-1}$  are attributed to C-H out of plane bending. The absorption frequencies at  $775$  and  $753\text{ cm}^{-1}$  are due to C=C stretching (Skeletal). The frequencies at  $542$ ,  $475$  and  $430\text{ cm}^{-1}$  are due to the C-Co deformation, C-C deformation and  $\text{Coo}^-$  rocking mode of the compound respectively.



**Fig.3 FTIR spectrum of LVCC crystal doped with strontium chloride**

### Thermal Analysis

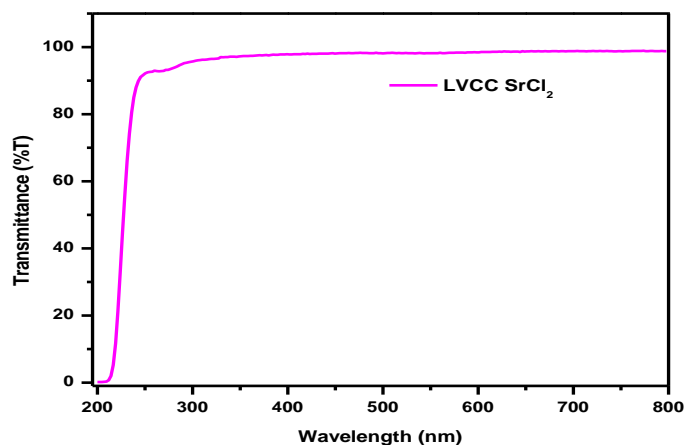
The thermogram of LVCC crystal doped with strontium chloride is shown in fig.4. The grown crystal has high amount of thermal stability upto  $250^{\circ}\text{C}$ . The strong endothermic peak observed at  $276.9^{\circ}\text{C}$  is assigned to the melting point of the given compound. The second stage of decomposition was observed at the temperature range of  $250^{\circ}\text{C}$  to  $290^{\circ}\text{C}$  accompanied with a weight loss of 87.5% corresponds to the loss of L-Valine molecules. In the third stage ( $290^{\circ}\text{C} - 560^{\circ}\text{C}$ ), the remaining 10% loss of the grown LVCC crystal doped with strontium chloride is due to the removal of cadmium and other volatile compounds.



**Fig. 4 TGA/DTA spectrum of LVCC Crystal doped with strontium chloride**

#### UV – spectral Analysis

The optical transmission spectrum of LVCC crystal doped with strontium chloride is shown in fig. 5. From the graph it is concluded that the grown crystal have highly transparency over a considerable region of wavelength in uv and visible region. The lower cut off wavelength was found to be 240 nm attest the usefulness of this material for non linear optical applications [23].



**Fig. 5 The optical transmission spectrum of LVCC crystal doped with strontium chloride**

## CONCLUSION

The title compound L-Valine Cadmium Chloride (LVCC) crystal doped with strontium chloride has been grown by the conventional slow evaporation technique. The sharp peaks from the observed powder XRD pattern of LVCC doped with strontium chloride crystal confirmed the crystalline nature. The functional groups present in the compound has been explained on the basis of FTIR studies. The UV cutoff wave length has been found out as 240 nm. All characterization properties revealed the NLO application of grown crystal.

## REFERENCES

1. V.G.Dmitriev, G.G.Gurzadyan, D.N.Nicogosyan, Hand book of Non-Linear Optical Crystals, Springer Verlag, New York, **1999**.
2. M.S.Wong, C.Bosshard, F.Pan, P.Gunter, Adv.Material, **1996**, 8, 677.
3. M.G.Popadopoulos, J.Leszczynski, A.J. Sadler, Non-Linear Optical Properties of Matter: From Molecules to Condensed Phases, Kluwer, Dordrecht, **2006**.
4. H.S.Nalwa, S.Miyata, Non-Linear Optics of Organic Molecules and Polymers, CRC Press, Boca Raton, **1997**.
5. J.Zyss, J.F.Nicoud, M.J.Coquillay, J.Chem. Phys., **1984**, 81, 4160.
6. R.A.Hann, D.Bloor, Organic Materials for Non-linear Optics, Special Publication, The Royal Society of Chemistry, London, **1989**.
7. M.H.Jiang, Q.Fang, Adv. Materials, **1999**, 11, 1147.
8. C.Justin Raj, S.Dinakaran, S.Krishnan, B.Milton Boaz, R.Robert, S.Jerome Das, Optical Communication, **2008**, 281, 2285.
9. M.Lydia, Caroline, A.Kandaswamy, R.Mohan, S.Vasudevan, J.Cryst. Growth **2009**, 211, 1161.
10. K.Kirubavathi, K.Selvaraju, R.Valluvan, N.Vijayan, S.Kumararaman, Spectrochim. Acta A **2008**, 69, 1283.
11. S.Moitra, T.Kar, J.Crys, Growth, **2008**, 310, 4539.
12. J.Chandra Sekaran, P. Ilayabarathi, P.Madeswaran optics Communication.
13. J. Chandrasekaran, P.Ilayabaruthi, P.Madeswaran, Rasayan J.Chem, **2011**, 4,320.
14. Bikshandarkoil, R.Srinivasan, Rita, N.Jyai, Spectro Chimica Acta part A: Molecular and Biomolecular Spectroscopy, **2014**, 120, 621.
15. A Puhaj Raj, C.Rama Chandra Raja, Spectro Chimica Acta Part A: Molecular and Bio Molecular Spectroscopy, **2012**, 97, 83.
16. M.K.Sangeetha, M.Mariappan, G.Madurambal, S.C.Mojumdar, J.Therm. Anal. Calorim **2012**, 108, 887.
17. C.Ramachandra Raja, A.Antony Joseph, Spectro Chimica Acta part A: Molecular and Biomolecular Spectroscopy **2009**, 74, 825.
18. Deepa Janana Kumar, P.Mani, Int. J. Chem, Tech. Research **2013**, 4, 1679.
19. S.Moitra, S.K.Seth, T.Kar, J.Crys. Growth **2010**, 312, 1977.
20. R.Parthasarathy, R.Chandra Sekaran, Ind.J.Pure and App. Phys. **1966**, 4, 293.
21. J.Chandrasekaran, P.Ilaya Bharathi, P.Matheswaran, P.Mohammed Kutti, S.Pari, Optik-Int. J. for Light and electron Optics, **2012**, 123, 1407.
22. P. Madeswaran, J.Chandrasekaran, Optik – Int. J.for light and electron optics, **2011**, 122, 1128.
23. C. Besky Job, Sch. Res. Lib. Arch. App. Sci. Res. 7 (**2015**) 118-128.