International Journal of Emerging Technology in Computer Science & Electronics (IJETCSE) ISSN: 0976-1353 Volume 25 Issue 5 – APRIL 2018 (SPECIAL ISSUE).

GROWTH AND CHARACTERIZATION OF THIOSEMICARBAZIDE MANGANESE SULFATE (TSCMnSO4) SINGLE CRYSTAL BY SLOW EVAPORATION METHOD

S. Janet Priyavathani[#1], P. Gandhimathi[*2]
[#1,*2]Department of Physics, Kings Engineering College, Irungattukottai, Sriperumpudur, Chennai-602117.
[#1]Corresponding author: E-Mail: nilageetham@rediffmail.com

***Abstract*-A single crystal of Thiosemicarbazide Manganese Sulfate (TSCMnSO4) was successfully grown by method of slow evaporation at room temperature. The crystals were characterized for spectral, optical and second harmonic generation properties. The Thiosemicarbazide Manganese Sulfate crystallizes in triclinic system. The occupation of molecular groups was identified by FTIR study. Optical transference of the grown-up crystal was investigated by UV–visible spectrum. The 1064nm wavelength of Nd: YAG laser light used for finding NLO property of crystal and measured SHG efficiency was 0.16 times greater than pure KDP.**

Key Words: X-ray diffraction, FTIR, UV Spectrum, SHG efficiency.

I.INTRODUCTION

Nowadays Crystals are the pillars of modernized technology. Crystal growth play an essential role different field. In the present days, a growing passion on crystal growth processes, mainly in view of the rising demand of materials for hi-tech applications (Brice, 1986; Nalwa & Miyata, 1997). The significant rudiments of an amino acid are carbon, hydrogen, oxygen, and nitrogen, though other elements are found in the side-chains of particular amino acids. Amino acids are main organic compounds containing amine (NH_2) and carboxylic acid (-COOH) occupational groups, usually along with a side-chain definite to each amino acid. The search for amino acid derivatives of nonlinear optical (NLO) materials has excited large interest for their potential applications in optical communications, optical storage devices and optoelectronics (Fracier C and Cockerham M.P, 1987; Prasad and Williams, 1991; Chemla and Zyss, 1987). Amino acids are generally classified by the properties of their The importance of amino acids in NLO applications is due to fact that all the amino acids have molecular chirality, absence of strongly conjugated bonds and zwitterionic character of the molecule and more predominantly they crystallize in non-centro symmetric space group (Rameshbabu R, Vijayan N, Gopalakrishnan R and Ramasamy P,2006; Lydia Caroline M, Sankar R, Indirani R.N and Vasudevan S, 2009). The SHG activities was observed in the grown material. The prepared crystal was characterized by single crystal XRD, FTIR, Power XRD, UV–Visible spectral analysis and NLO studies.

II.EXPERIMENTAL TECHNIQUE

Material preparation: ThioSemicarboxide MnSO4 which is available in the market was purified by repeated crystallization using deionized water as the solvent. TSCMnSO4 was synthesized by dissolving an equi molar ratio of recrystallized TSC and MnSO4 in purified distilled water and stirring well two hours using a magnetic stirrer and the mixer was filtered by Wattman filter paper. The purified solution was allowed for slow evaporation at room temperature. The good quality crystal was harvested in a period of 18 days.

RESULTS AND DISCUSSION

UV-Visible spectral analysis: UV-VIS spectrum was used to record the absorption range from 200nm-800nm as shown in the figure.1. From the absorbed spectrum cutoff wavelength is locate at 267 nm. There is no absorption band in between 290 nm to 800nm.So that absence of any overtone and absorption due to electronic transition above 270nm. This illustrates no absorption in visible region. Hence UV absorption studies reveal that the TSCMnSO4 is one of the suitable materials for exhibiting second harmonic generation properties (SHG) in the entire visible region (Caroline L and Vasudevan S, 2009).

Single Crystal X -ray Diffraction Analysis: Thiosemicarboxide MnSO4 crystals has been investigated by single crystal X-Ray Difrraction and lattice parameters obtained are a =4.910A˚, b= 6.001A˚, and c=7.319A˚, & α=77.29°, β=77.22° and γ=83.86° and the cell volume =204.8A˚. The structure is confirmed to be triclinic system.

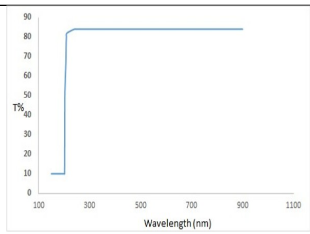
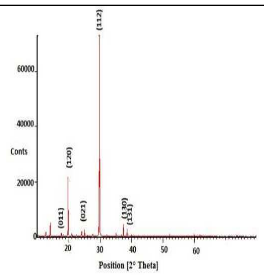


Figure.1. UV-Vis spectrum of TSC MnSO4 Crystal

Powder XRD Studies: Powdered sample of Thiosemicarboxide $MnSO_4$ crystals is subjected to powder X- ray studies. As in figure.2, the strong observable peaks point out the immensely crystalline nature of the sample. Powder XRD reveals that strength



of the Thiosemicarboxide $MnSO_4$ was initiate maximum in the direction [021] and [112] respectively. The powder X-ray diffraction studies have been carried out to verify the nature of the crystallinity and to conclude the lattice parameters of the mature sample.

Figure.2. Powder X-ray diffraction spectrum of TSC $MnSO_4$Crystal.

Fourier Transform Infrared (FTIR) analysis: The infrared spectrum of the developed crystal has been taken using in the range of 400-4000cm^{-1}.The spectrum of TSC $MnSO_4$ as shown in figure.3. The presence of the functional groups in TSC $MnSO_4$ crystals are verified. The bands appear in the area 833cm^{-1} is assigned to C=S.N-N vibration is obtained at the peak 999cm^{-1}. NH $^{+}$symmetric bending is at 1886cm^{-1}.

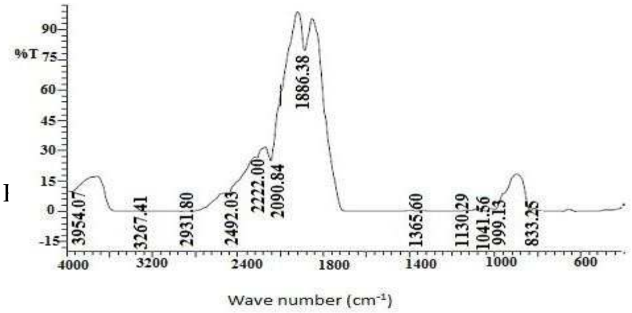


Figure.3. FTIR spectrum of TSC $MnSO_4$ Crystal

Second Harmonic Generation: The effectiveness of second harmonic generations (SHG) in the crystal was deceived by the modified version of the powder technique developed by Kurtz and Perry (Kurtz S.K and Perry T.T ,1968) using an Nd: YAG, 10ns laser with a repetition pulse rate of 10Hz running at1064nm.The fine powder of sample crystal was compactly packed in a micro-capillary tube and riding in the path of the laser beam of 3.6mJ pulse energy obtained by splitting the original laser beam. The O/P light was passed through a monochromatic transmitting only the second harmonic (green) light at 532nm. The high intensity of green light was registered by a photo multiplier tube and it was converted in to an electrical signal. This signal was displayed on the oscilloscope screen. The identical size of Potassium Di-hydrogen Orthophosphate (KDP) was referred as the material in the SHG measurements conversion efficiency was computed by the ratio of amplitude of the TSC $MnSO_4$ sample to that of the KDP signal amplitude recorded for the same input powder. The SHG efficiency of the TSC $MnSO_4$ crystal is found to be 0.16 times greater than that of KDP.

In the capillary tube, the adequacy of the frequency conversion will vary with the particle size and the direction of the crystallites. Hence, higher efficiency may be expected to be achieved with single crystals by optimizing the phase matching (Lawrence and Thomas, 2012).

IV.CONCLUSION:

TSCMnSO4 Single crystal has been grown by slow evaporation method at room temperature. The sharp and well defined peaks of Powder XRD pattern shows the purity and crystalline nature of the crystal. Single crystal XRD studies reveals that the grown crystals belongs to triclinic system.The FTIR analyse the presence of the functional groups. The lower cutoff wavelength at 267nm and wide transparency range (290nm-800nm)observed from UV- Vis spectral studies.SHG studies validate the use of TSCMnSo4 crystal as suitable material for NLO applications.

V.REFERENCES

Brice J.C, Crysta, Growth Processes Book, Blackie (Glasgow and New York), 1986, 298

Fracier C and Cockerham M.P, Journal of the Optical Society of America B, V4, 1987, 1899-1903. Kurtz S.K, Perry T.T, Journal of Applied Physics, V39, 1968, 3798-3813.

Lawrence G.M, Thomas Joseph Prakash J.P, Growth and Characterization of pure and Glycine doped cadmium thiourea sulphate (GCTS) crystals, Spectrochimica Acta Part A, 91, 2012, 30-33.

Lydia Caroline M, Sankar R, Indirani R.N and Vasudevan S, Materials Chemistry and Physics Journal, 114, 2009, 490-494.

Nalwa H.S, Miyata S, Nonlinear optics of organic molecules and Polymers, Book review, CRC Press, Boca Roton, FL, 1997, 8132-840.

Prasad P and Williams D.J, Introduction to nonlinear effects in molecules and Polymers, Wiley, New York, 1991.

Rameshbabu R, Vijayan N, Gopalakrishnan R and Ramasamy P, Crystal Research and Technology, V41, 2006, 405- 410