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RESEARCH ARTICLE

Investigation on New Semi ORGANIC NON-LINEAR OPTICAL MATERIAL-THIO SEMICARBAZIDE CADMIUM ACETATE

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Abstract

Non-linear optical materials play a major role in the hands of young researchers due to their wide applicationns in photonics and opto electronics. In the present work Thiosemicarbazide cadmium Acetate (TSCA) single crystals were grown aqueous solution by slow evaporation technique. The structural parameters of the grown crystal were estimated by powder crystal x-ray diffraction. FTIR studies confirm the functional groups present in the grown crystal. Thermal studies indicate that the material possess optimum thermal stability. SHG conversion efficiency of TSCA was determined using Kurtz powder technique and found out to be two times that of potassium dihydrogen orthophosphate.

INTRODUCTION

For any device fabrication in electronic industry pure and defect less single crystals are needed. Many device applications of NLO require single crystals in bulk form. This is achieved only with semi organic crystals which exhibit wide transparency and good crystal morphologies. The present work focuses on thiosemi Carbazide Cadmium acetate (TSCA) crystals grown in a remarkable manner. Recently interest is focussed on semi organic crystals, which have the combined properties of both inorganic and organic crystals. Semi organic Crystals have large nonlinearity, high resistance and good mechanical hardness.

2. Experiment

Synthesis:

$Cd(CH_3Coo)_2 + NH_2 – NH – CS – NH_2$ -- $Cd(NH_2 – NH- CS – NH_2)(CH_3Coo)_2$. (TSCA)

Thiosemi Carbazide Cadmium Acetate was synthesised by taking Cadmium acetate and thiosemicarbazide in the ratio of 1:1 and dissolved in deionised water. The solution was stirred well and the prepared solution was dried at room temperature. For purity of synthesised salt recrystallisation was done. To avoid decomposition of solute molecules temperature was not allowed greater than 50°c.

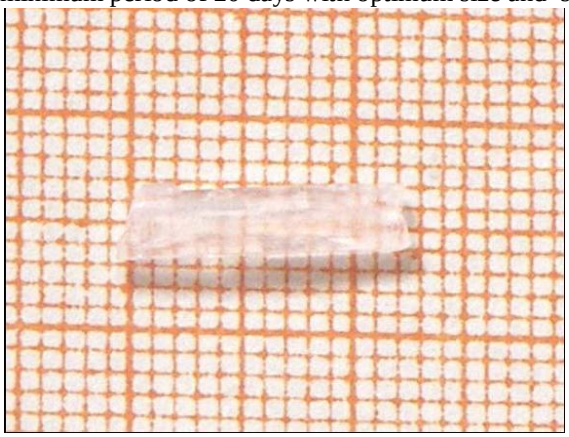
2.1 Solubility:

The solute was stirred in water in an airtight container at relevant temperature. Solubility was determined in the range 30 – 45°C. The concentration of solute was determined gravimetrically after the saturation point of solute. The process is repeated to estimate the equilibrium concentration of solute at various temperatures.

2.2 Growth:

The technique used for growing this crystal is slow evaporation process .Saturated Thio semicarbazide Cadmium acetate (TSCA) solution was prepared at room temperature with deionised water as a solvent. Using micro filter the

solution was filtered. In a dust free atmosphere the solution was taken in vessels. Crystals were grown with a minimum period of 20 days with optimum size and shape.



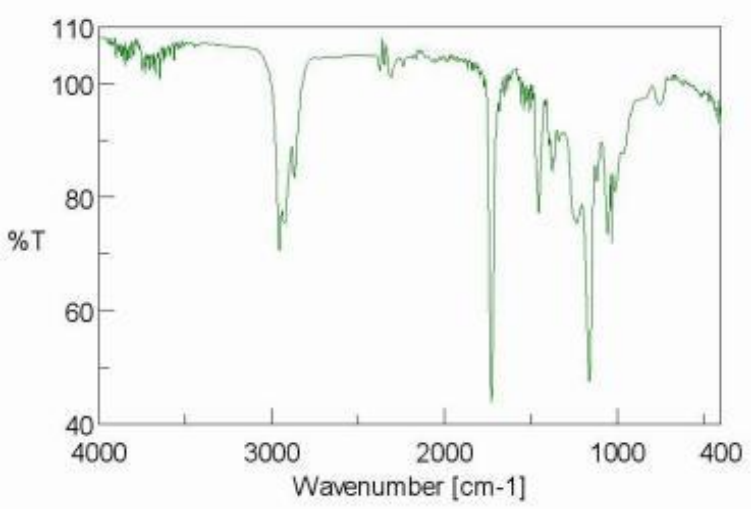
3. RESULTS AND DISCUSSION

3.1 X ray diffraction:

X RD indicated that the grown TSCA crystal belong to monoclinic system and lattice parameters are a = 6.675 A° b = 10.569 A° and c = 23.689A° and β = 109.20°.

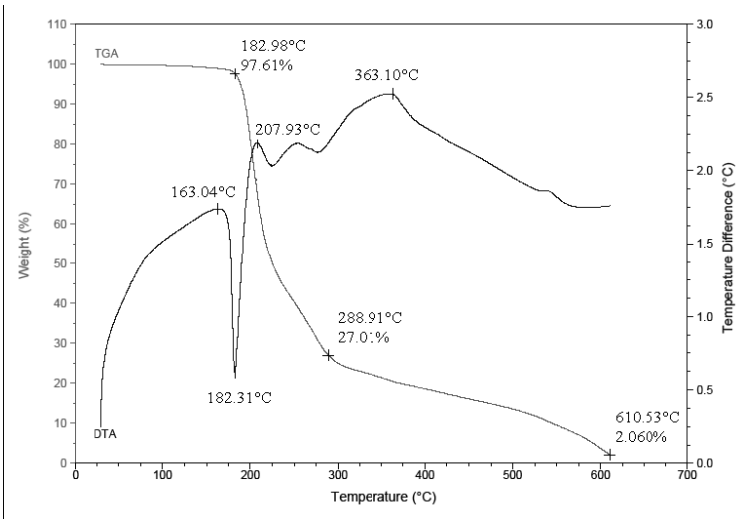
3.2 FTIR analysis

FTIR spectral analysis was carried out for TSCA crystal in the range 4000 & 400cm^{-1}. The observed spectrum is shown. In the high energy region there is a broad band between 2100 and 3500cm^{-1}. Due to O – H vibration intense sharp peak was observed at 3180 cm^{-1}. The involvement of NH_3^+ in hydrogen bonding is evident by fine structure of band in lower energy region. The band observed at 2929 cm^{-1} is due to NH_2 bending vibration in high energy region. The peak at 1418cm^{-1} is due to symmetric NH_3^+ bending. The bands appear in the region 1534cm^{-1} and 798cm^{-1} is assigned to C = S. In the lower energy region intense sharp peak of grown sample was studied using STA 1500 thermal analyser. The NLO property of TSCA was tested by Kurtz powder SHG test using an Nd: YAG laser.



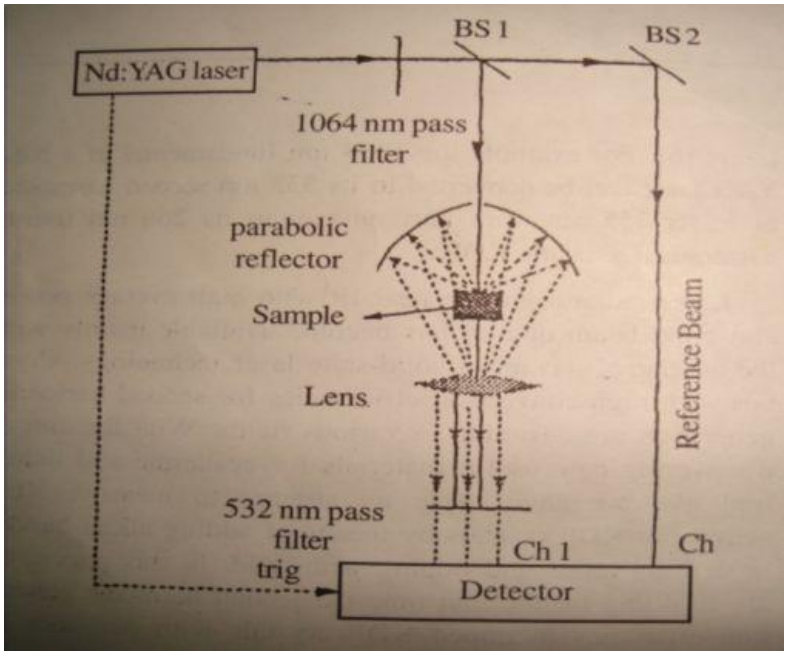
3.3 THERMAL ANALYSES:

Thermal behaviour of TSCA has been identified from TG/DTA.The sample was heated at the rate of 25*C/min.It has been observed that 27% of weight loss is between 182*C and 288*C. Careful observation in DTA curve infers that endothermic curve at 163*C corresponds to phase transformation.Below the decomposition no weight loss is observed and the grown crystal is stable upto 163*C. From this study it has been concluded that it is a promising material for NLO applications.



3.3 SHG

Kurtz powder technique was used for screening the materials for second harmonic generation. The fundamental beam of 1.064nm from a Q switched Nd-YAG laser was used to test the second harmonic generation property of TSCA crystal. The crystalline samples were powdered and compared with well known SHG materials such as KDP. KDP was also grounded and sieved into same size of crystalline sample material. Finally the powdered sample of TSCA was packed in micro-capillary tubes of diameter 1.5mm. Here, a pulse width of ions, repetition rate of 10Hz was used. The fundamental beam was filtered using an IR filter and photo multiplier was used as a detector. The output intensity was 2 times that of KDP. The second harmonic signal generated in the sample was confirmed from the emission of green radiation of wavelength 532nm.



4. Conclusion:

The non-linear optical properties of TSCA crystal has been studied for the purpose of assessing the possibility of SHG applications. The conversion efficiency was confirmed by emission of green light. Unit cell parameters were confirmed by single crystal XRD. FTIR spectrum of TSCA crystal was recorded using 6V FTIR spectrometer to

confirm vibrational structure of crystalline compounds with range of wave number 400 – 4000cm^{-1}. TG analysis indicated that the material does not decompose before melting.

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