

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 6, June 2015

Photoconductivity and FT-Raman Study of Cadmium Sulphate Doped L - Threonine Dihydrogen Phosphate Crystal

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ABSTRACT: Cadmium sulphate doped L- Threonine dihydrogen phosphate [LTDP] crystals have been successfully grown by slow evaporation method. Photoconductivity of grown crystal was established by photoconductivity meter. FT-Raman spectra of doped crystal were recorded and interpreted.

KEYWORDS: Slow evaporation, FT-Raman , Photoconductivity

I. INTRODUCTION

Amino acid based compounds are, in general, capable of producing second harmonic generation. This will be more useful in the fabrication of optoelectronic and photonic devices. In the recent years, efforts have been made on organic-metal mixed amino acid crystals in order to improve the chemical stability, laser damage threshold and nonlinear optical properties. Several researchers have carried out a lot of studies on pure and metal ions-doped amino acid crystals [1-4]. Hence, new nonlinear optical materials are needed for photonic applications and other device fabrications in optoelectronics. Amino acid material cadmium sulphate doped L-Threonine dihydrogen phosphate has been reported as a promising NLO material with SHG efficiency higher than that of KDP [5]. In the present study, the title compound cadmium sulphate doped L-Threonine dihydrogen phosphate were grown by slow evaporation technique. Characterization studies such as photoconductivity, FT-Raman studies have been carried out for the grown crystal. [9-12]

II. GROWTH OF CADMIUM SULPHATE DOPED LTDP CRYSTAL

Crystals of LTDP doped with cadmium sulphate were grown from the aqueous solution of L-Threonine (Loba) and ortho-phosphoric acid in 1:2 molar ratio mixed with 2 mol % cadmium sulphate by slow evaporation method. The aqueous solution was stirred continuously using a magnetic stirrer. The prepared solution was filtered and kept undisturbed at room temp. The solution gradually achieved supersaturation due to slow evaporation for the onset of growth process. After a period of 30 days, transparent crystals with dimensions $12 \times 3 \times 2 \text{ mm}^3$ were harvested. Figure 1 shows the photograph of as-grown cadmium sulphate doped LTDP crystal.

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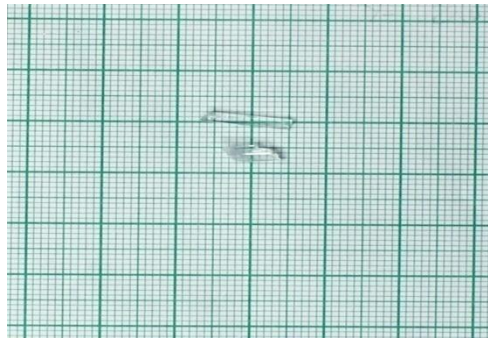
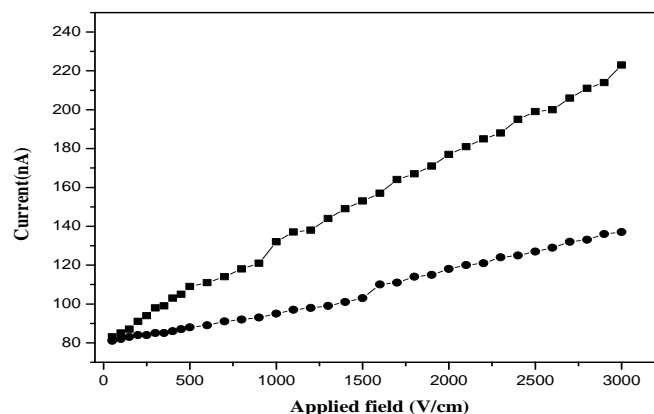


Figure1: Photograph of the as - grown cadmium sulphate doped LTDP crystal

III.PHOTOCONDUCTIVITY STUDIES

Photoconductivity measurements were made using Keithly 485 picoammeter. The applied electric field was changed from 2 V / cm to 14 V / cm without exposing the sample to any radiation and the corresponding dark current was recorded. The sample was then illuminated with a halogen lamp of 100W power and the resulting photocurrent was measured by varying the applied field in the same range as used in the case of measurement of dark current. Fig shows the plots of dark current (I_d) and photo current (I_p) against the applied field. It is seen from the plots that both I_d and I_p of the sample increase linearly with the applied field. It is observed from the plot that the dark current is always higher than photocurrent. The phenomenon of negative photoconductivity is explained by stockman model [6]. The negative photo conductivity in a solid is due to the decrease in the number of charge carriers (or) their life time, in the presence of radiation [7]. For negative photo conductor, forbidden gap holds two energy levels of which one is placed between the Fermi level and conduction band and the other is located close to the valence band. The second state has higher capture cross-section for electrons and holes. As it captures electron from the conduction band, the number of charge carriers in the conduction band gets reduced and the current decreases in the presence of radiation. Even though the material shows negative photoconductivity in the visible region, the material is capable of inducing electric polarization when the incident radiation is more intense for NLO activity.[13,14]



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IV.FT-RAMAN

Raman spectra of cadmium sulphate doped LTDP crystal recorded at room temperature using a Nicolet 5700 spectrometer with NXP FT- Raman module was used (number of scans ; 256, laser power at sample: 0.44w, resolution: 4 cm⁻¹ spectral range : 4000- 150 cm⁻¹).

The wave number ranges from 0 to 3500 cm⁻¹ and assignment for the modes is made on the basis of Raman vibrations in some similar complex molecules [5, 6]. The peak at 2047 cm⁻¹ shows N=C=S stretching vibrations. The peaks at 1346 cm⁻¹ confirm the presence of sulphate. The peak due to 1318, 1479 cm⁻¹ are due to Nitro groups. The peaks due to 1183,1247, 1109,931 cm⁻¹ confirm the presence of phosphate in the crystal. The peak at 1040 cm⁻¹ corresponds to amine group C-N stretching vibration. The bending vibrations of CH stretch are found corresponding to the peaks at 907,871,665,622 cm⁻¹. The peaks due to 701,739,769,804 , cm⁻¹ reveal the presence of alkene group.

V.CONCLUSION

Cadmium sulphate doped LTDP crystals were grown by slow evaporation technique. Photoconductivity investigations reveal the Negative Photoconductivity nature of the title material. Vibrational spectra of cadmium sulphate doped LTDP are registred and interpreted. The crystal display NLO activity. Spectral analysis measurement studies reveal that cadmium sulphate doped LTDP is a better candidate for Non- linear optical applications compared to other members of the amino acid family.

ACKNOWLEDGEMENTS

The author wishes to thank SAIF IIT Madras, Loyola College, crystal growth centre Bharath university for their kind support and help to complete this work.

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ISSN(Online): 2319-8753
ISSN (Print): 2347-6710

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(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 6, June 2015

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