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THE CHARACTERIZATION OF AN ORGANIC SINGLE CRYSTAL- GLYCINE DOPED CONGORED DYE

R.Raja[1],M.Mathiyalagan[1*],V.Santhanam[2],P.Kurinjinathan[1]
[1]Department of Physics, [2]Department of Chemistry
SCSVMV UNIVERSITY, KANCHIPURAM 631561, India.
knmsc@yahoo.com

Abstract— **Glycine doped Congo red dye, an organic material was doped and successfully grown by slow evaporation method. The cell parameters of the grown crystal were obtained from the single crystal X-ray diffraction analysis and the presence of functional groups are identified by FTIR studies. Its optical properties are examined by UV-Vis NIR analysis. Thermal analysis carried out for Glycine doped Congo red dye. The Vickers micro hardness values were measured for grown crystal. The second harmonic generation efficiency was evaluated experimentally to understand NLO activity of the grown crystal.**

I. INTRODUCTION

Non linear optical materials with high optical non linearity have been subjected to intense research in the last few years. The development of photonic and opto-electronic technologies on the growth of NLO materials with high optical responses and the development of more efficient materials have potential applications in harmonic generation amplitude and phase modulation switching and other optical signal processing devices. Unremitting efforts have been made to produce highly efficient NLO materials capable of generating second harmonic generation [1-3].

Amino acids are interesting materials as they contains proton donor carboxylic acid group and proton acceptor amino group which provide the ground state of charge symmetry of the molecule required for SHG[4,5].Glycine is the simplest amino acid. It is reported that the glycine addition has enhanced the non linear optical property of glycine hydrofluride[6], glycine bariumdichloride[7], glycine thiourea[8] are the some examples which provide their applications in the field of SHG.

In this paper we report the growth of Glycine doped with a dye named as Congored single crystals were grown by slow evaporation technique and to study its characterization like single crystal XRD analysis for cell parameters spectral analysis. Fourier Transform IR spectrum gives the presence of functional group and optical transmission and absorption by UV-Vis spectrum the thermal stability of the crystal was studied by TGA and DTA .Micro hardness of the crystal was carried out by Vickers hardness tester and the second harmonic generation efficiency was evaluated experimentally to understand the NLO activity of the crystal.

II. SAMPLE PREPARATION

In the form of reasonable size favorable qualities of single crystal are crucial for the practical applications. In the existent work, the single crystal of Glycine doped Congo red dye was grown using double distilled water has the convenient solvent by solution evaporation method at constant temperature [9-11]. The supersaturated solution was blended well to attain the homogenous solution. The solution was kept for evaporation to dry at room temperature. The purity of crystal was elevated by successive recrystallization process which was free from macro defects by self-nucleation of saturated solution. Single crystals of Glycine doped Congo red dye have been harvested in the period of 20-25 days were shown in figure 1.

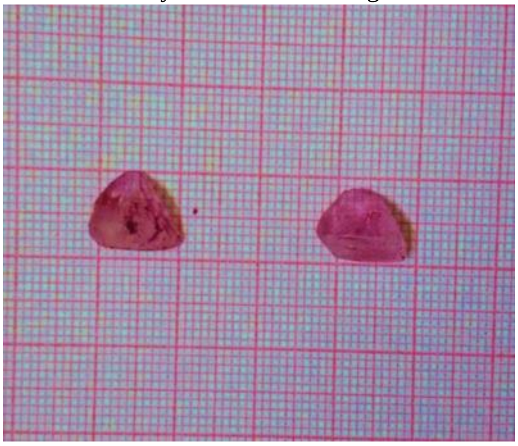

Figure 1 single crystal of glycine doped Congo red dye

III. RESULTS AND DISCUSSION

A. STRUCTURE OF THE CRYSTAL

To confirm the crystallinity of the grown crystals and the unit cell parameters of Glycine doped Congo red dye, X-Ray diffraction analysis carried out to find the crystal structure with the help of single crystal X-Ray diffractometer. It was found that Glycine doped Congo red dye having orthorhombic system. The lattice parameter values were obtained. They werea = 6.956 Å, b = 20.672 Å and c= 21.934 Å.

B. FTIR ANALYSIS

The FTIR was recorded in the frequency range of 400 - 4000 cm^{-1} to identify the functional groups in KDP doped Congo red dye was shown in figure 2. The KBr pellet method was used to analyze the sample. The various functional groups present in the grown crystal were identified. The observations of 3099 cm^{-1}very broad peak due to Hydrogen bonded O-H stretching, 2894cm^{-1} peak due to –C-H Stretching, 1598cm^{-1} and 1496cm^{-1} confirms –C-C stretch of aromatic rings,1399cm^{-1} and 1328cm^{-1} peaks confirms that C-N stretching of grown crystal.

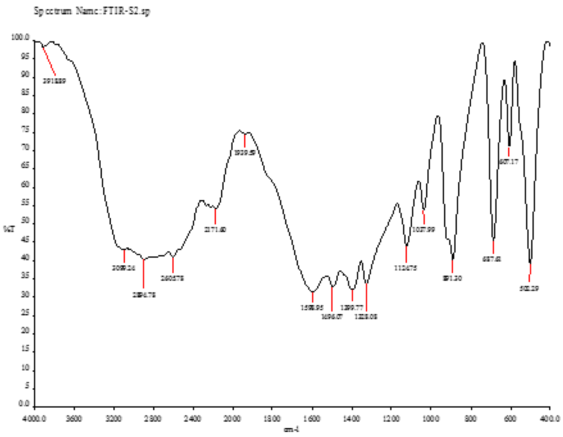

Figure 2 FTIR spectrum of glycine doped Congo red dye

The transmission range of the crystal was used to know the suitability of KDP doped Congo red dye crystals for optical applications. The wavelength range between 190nm and 1100nm was made by UV-Vis spectrometer (BERKIN ELMEP LAMBDA 35)[11-13]. The absorbance is not enrolled in the wavelength range starting from 256nm to 1100nm is an advantage for materials having NLO properties. The sharp fall of the transmittance to zero was observed in 256 nm is indicating the single crystal in UV region is shown in figure 3,4. From the analysis the crystal is suitable for NLO applications.

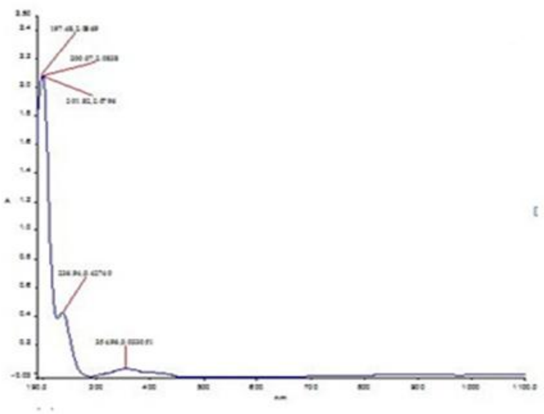

Figure 1 UV absorbance graph of glycine doped Congo red dye

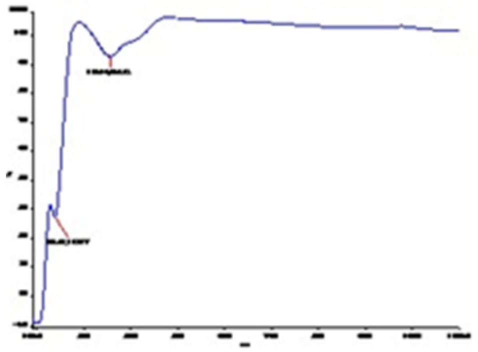

Figure 2 UV transmittance graph of glycine doped Congo red dye

C. SHG EFFICIENCY

The NLO property of potassium dihydrogen phosphate doped Congo red dye crystal was performed by Kurtz Perry powder technique [14-15]. The crystal was grained into powder and densely packed in the micro capillary tube of uniform diameter. A quanta Ray Spectra physics ND:YAG laser producing pulses with a width of 8ns and a reaction rate of 10Hz was used. The laser was focused to fall on the powder sample. SHG was confirmed by the emission of green radiation (532nm) and the optical signal was controlled by photomultiplier tube (PMT) was converted into voltage output in CRO.[16] The powder SHG efficiency of KDP doped Congo red dye was found to be 0.56 times that of the standard KDP crystal.

D. MICROHARDNESS MEASUREMENT

To find the mechanical hardness of the grown crystal was also deciding properties for post-growth process and device fabrication. Micro hardness was measured using Vickers micro hardness tester. The applied load was varied from 25g to 100g for constant indentation period. The Vickers hardness number Hv is calculated using the relation

$Hv=1.854p/d^2 kg/mm^2$

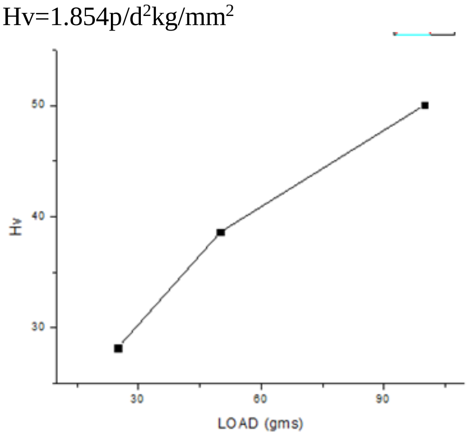

Figure 5 hardness graph for Glycine doped Congo red dye

Where p is the indenter load in kg and d is the diagonal length of the impression in mm [16]. The graph shows the variation of Hv with applied load reveals that the hardness increases with the increase of load in figure 5.

IV. Conclusion

Glycine doped Congo red dye crystal was grown by solution evaporation technique. The Fourier transform infra-red spectroscopy studies carried out it confirms the functional groups of dopant present in the grown crystal. From the results of single crystal XRD, the cell parameters are observed that the grown crystal belongs to triclinic structure. The UV-Vis studies reveals that the grown crystals having transmission in the visible range and having sharp fall in the range of 256nm. Then the grown crystals subjected to Kurtz Perry powder method to test the efficiency of the relative second harmonic generation reveals the NLO property of the grown crystal are compared with standard KDP. The microhardness of the crystal was tested by Vickers hardness tester,it shows the crystal hardness increased for various loads.

V. Acknowledgment

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