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Growth and characterization of bis-glycine cadmium chloride (BGCC) single crystals

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Abstract: A single crystal of bis-glycine cadmium chloride ($C_4H_{10}CdCl_2N_2O_4$) is the one of organic NLO materials extensively studied in the recent years. In our attempt, good quality single crystal of BGCC has been successfully grown from aqueous solution by slow evaporation technique at a temperature of 305 K. The grown crystals were subjected to single crystal XRD studies to confirm the crystalline nature and the structure. FTIR and UV-vis-NIR spectral analysis confirms the presence of functional groups and the optical absorption of the BGCC single crystal respectively. Dielectric studies on the grown crystal shows that both the dielectric constant and dielectric loss decreases slowly with increasing frequency and attains uniform value at higher frequencies in the observed region.
Key words: bis-glycine cadmium chloride (BGCC), single crystals, Growth and Characterization.

1. INTRODUCTION AND EXPERIMENTAL

Nonlinear optical single crystal have gained lot of significance because of their number of applications such as second harmonic generation, frequency mixing, electro-optic modulation etc[1,2]. In the recent times, single crystal of amino acid single crystals have gained due importance because it forms complexes with simple inorganic salts and exhibits excellent properties. In amino acids, glycine is a chemically flexible structural unit and it acts as both acid as well as base and it combines with both cations and anions [3]. Semi-organic single crystal are novel materials for NLO applications, hence they have gained more attention because they possess increased hyperpolarizability and hardness. Glycine (NH_2-CH_2-COOH) is the simplest amino acid. Some of the glycine compounds exhibit ferroelectric property and some of them reported to possess NLO properties [4]. In this report, the growth and characterization of glycine cadmium chloride (BGCC) crystals have been discussed. Single crystal of glycine cadmium chloride was grown by slow evaporation technique at room temperature. The double distilled water was taken in a glass beaker and a known amount of glycine and cadmium chloride was dissolved in the ratio 2:1. The saturated solution was dissolved using magnetic stirrer at room temperature and then filtered using filter paper. Transparent seed crystals were formed in a period 7 days. Bulk single crystals of glycine cadmium chloride were grown from the selected seed crystals in a period of 20 days. The harvested

bulk single crystals were colorless and transparent. Defect free crystals were chosen for further experimental studies.

2. RESULTS AND DISCUSSION

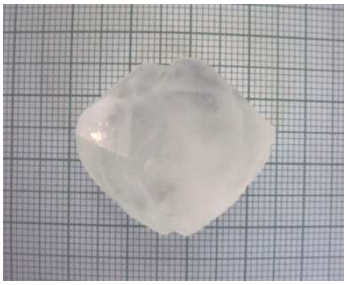

Fig.1. The grown BGCC crystal

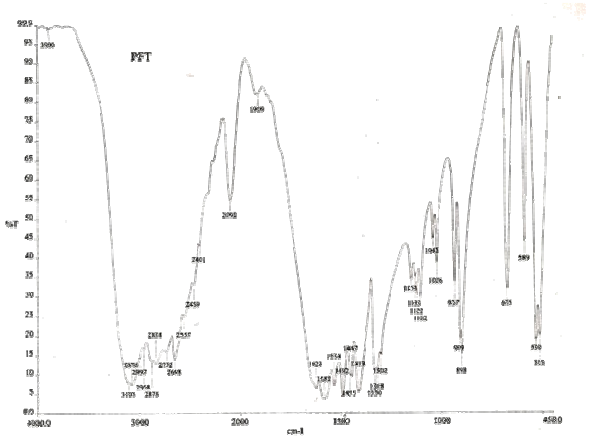

Fig 2. FTIR spectrum of pure BGCC crystal

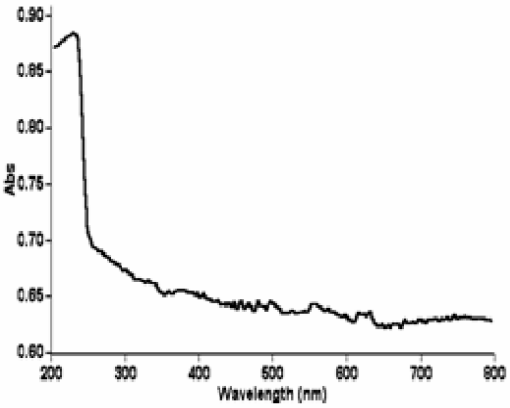

Fig 3. UV-vis-NIR spectrum of BGCC

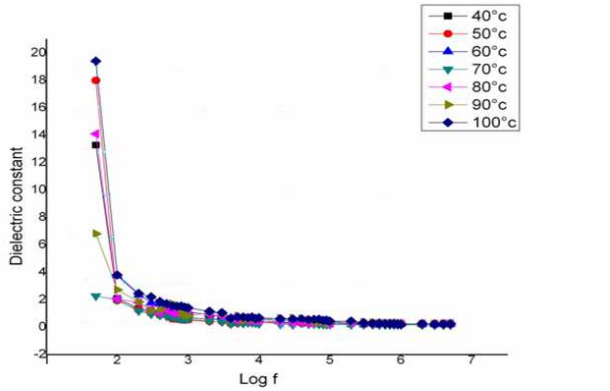

Fig.4 Dielectric Constant Vs Log f

X-ray diffraction analysis: The well grown bis-glycine cadmium chloride single crystal was subjected to single crystal X-ray diffraction analysis which reveals that the crystal belongs to the monoclinic primitive system with lattice parameters in Å as a=8.2715, b=9.0543 and c=13.7283 with volume 987.901Å^3.

FT-IR analysis: In this work, the bis glycine cadmium chloride single crystal was analyzed by Fourier transform infrared spectroscopy using JASCO FT-IR 460 plus spectrometer by KBr pellet technique in the range 400-4000 cm^{-1}. The obtained FTIR spectrum is shown in fig 2. The peak at 1330 cm^{-1} is due to CH_2 stretching. The absorption taking place at 1445 cm^{-1} is due to bending of CH_2. The absorption occurring at 1026 cm^{-1} is responsible for stretching of (C-N).Absorption at 513cm^{-1} is because of the rocking of COO^-.

UV-Visible spectral studies: To determine the optical transmission range, selected optically clear surface of the grown crystal was analyzed by UV-NIR in the wavelength range between 200-800 nm (fig 3). The crystal shows excellent transmittance in the visible region. As observed in the spectrum, there is no significant absorption in the range between 300-800 nm hence the crystal can be used for NLO application. The crystal has the cutoff wavelength at 250 nm.

Dielectric studies: Dielectric constant Fig 4 and dielectric loss measurements were carried out on BGCC crystal. The result reveals that both the dielectric constant and dielectric loss decreases slowly with frequency.

The variation of dielectric constant is due to incorporation of metal ions inside BGCC crystal lattices and also, the characteristic of low dielectric loss with high frequency for the sample suggests that the crystal possesses enhanced optical quality with lesser defects and this parameter plays a vital role for the construction of devices for non-linear optical materials [5].

3. REFERENCES

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