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GROWTH AND CHARACTERIZATION OF SEMI-ORGANIC NLO MATERIAL: GLYCINE POTASSIUM CHLORIDE (GPC)

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ABSTRACT

Single crystals of Glycine Potassium Chloride (GPC), a semi organic nonlinear optical material has been grown from solution by slow evaporation at ambient temperature. The growth of crystals has been carried out at various pH values and the growth was confirmed at pH 6. The chemical composition of the grown crystals was determined by the FTIR spectra. The crystalline nature and its various planes of reflections were observed by the powder XRD. The structure is built from alternate layers of Glycine organic molecules and inorganic layers consisting of K^+ ions and Cl^- ions. The grain size is found to be 5 microns using SEM. The SHG was confirmed using the Kurtz powder technique.

Keywords: semi organic, nonlinear optical, slow evaporation, inorganic layers, grain size,SHG

INTRODUCTION

In recent years, organo-inorganic hybrid materials have attracted considerable attention. In particular, the inorganic derivatives of protein amino acids are often attributed to symmetric groups without an inversion centre mostly to polar symmetry groups. Their crystals have properties whose symmetry is described by odd -rank tensors such as pyro-electric effect, spontaneous electric polarization, piezoelectric effect, generation of second optical harmonics, etc. Moreover crystals that belong to the eleven enantiomorphic point groups, having no mirror reflection planes exhibit optical activity, which is described in terms of the axial generation tensors. While the structures of most amino acids are well defined, the structures of the derivatives of the protein amino acids with inorganic components are not. This paper defines the crystal structure of glycine potassium chloride [GPC]. This has been investigated by the FTIR studies, its crystalline nature is studied by the powder XRD, the transmittance and absorbance of electromagnetic radiation is studied through UV-Visible spectrum and its grain size is 5 microns is confirmed by SEM studies.

EXPERIMENTAL

Synthesis and crystal growth:

GPC was synthesized from analytic grade of Glycine and Potassium Chloride (Merck) in equimolar ratio and dissolved in triple distilled water. The pH of the solution at super-saturation is kept at 6.0. The solution is filtered and transferred to a Petri dish for crystallization. This compound is re-crystallized 2 times for purity. Then the pure samples of seed crystals are taken and characterized.

Characterization:

The crystals were characterized by FTIR spectroscopy, powder XRD, UV-Visible spectroscopy and SEM.FTIR spectra were recorded on Shimadzu IFS 66V FTIR.

Powder XRD was obtained on a PHILIPS X'PERT MPD system. The absorption spectrum for the title crystal was recorded using JASCO corp., V-570, and Rev.1.00 UV-VIS spectrometer in the region 190-2500nm .Surface analysis of glycine potassium chloride is carried out through JSM 6360 JEOL/EO make. The crystals were evaluated by the Krutz and Perry (1968) powder technique using a Q-switched, mode

locked Nd : YAG laser. A micro-crystalline material of KDP available at the Indian Institute of Science was used for comparison in the SHG measurements.

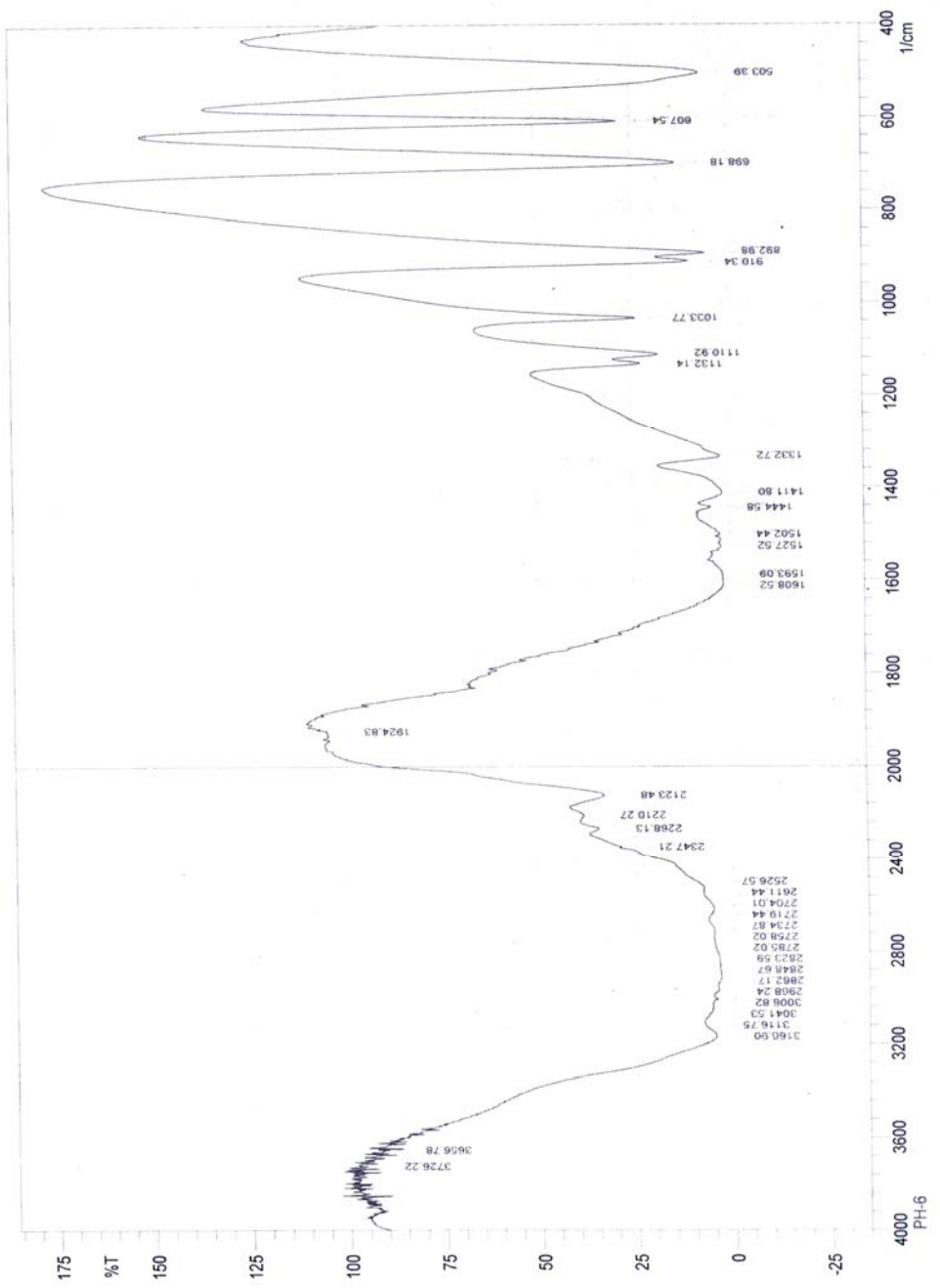
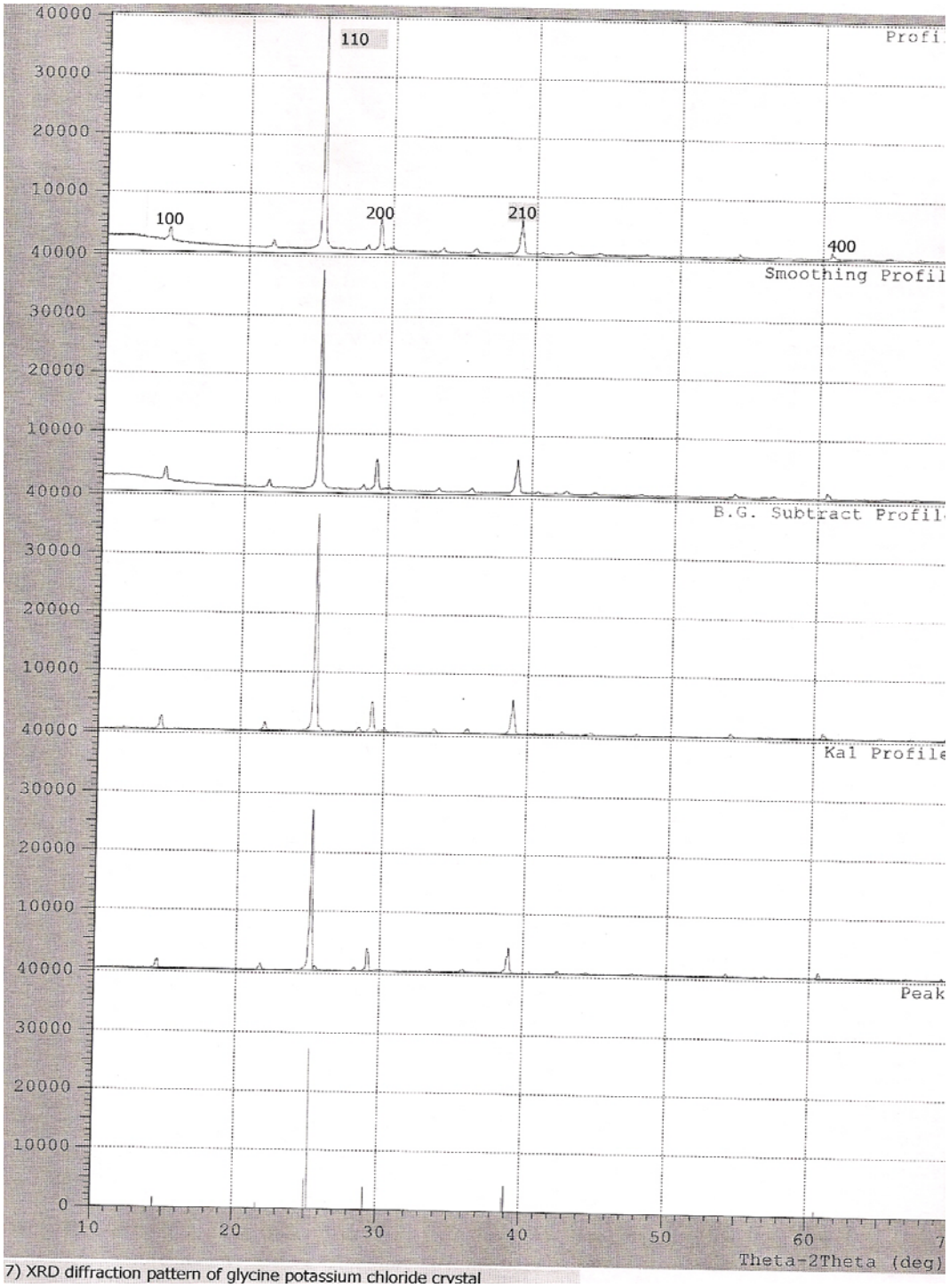


Fig-1



7) XRD diffraction pattern of glycine potassium chloride crystal

Fig-2

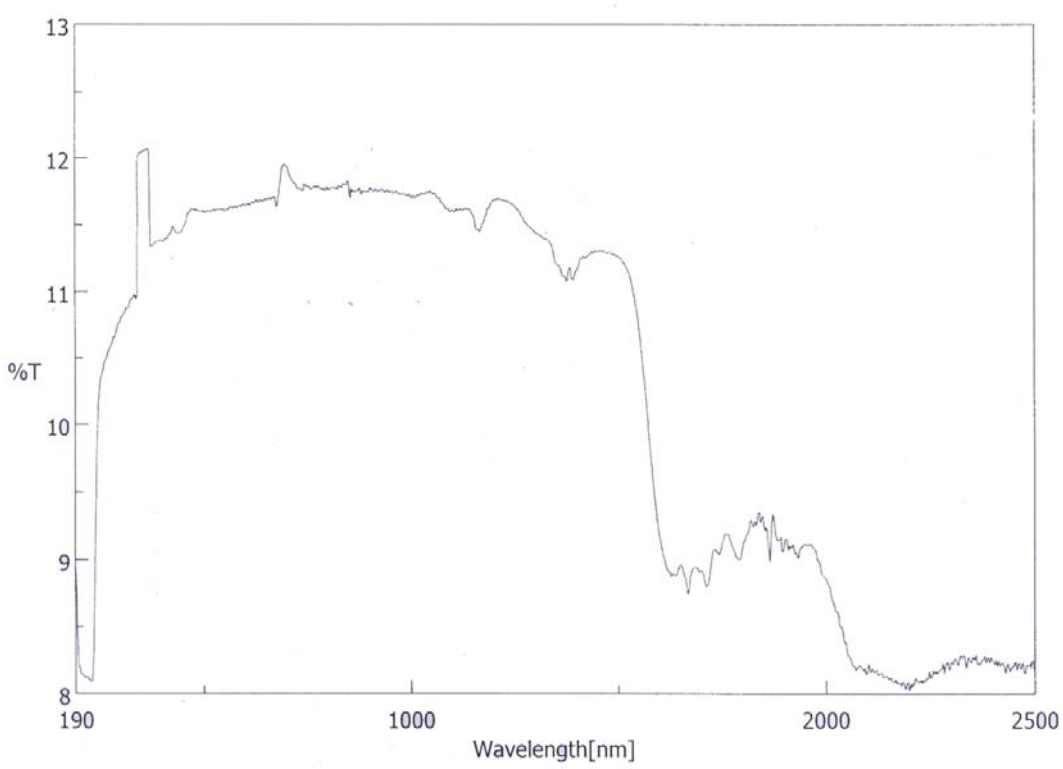


Fig.-3: UV-VIS spectrum of glycine potassium chloride crystal

Table-1: Frequencies of the fundamental vibrations of GPC

Frequency in wave number (cm^{-1})	Assignment of vibration
3167	N-H -Stretching
2734 to 3006	NH^{+}_{3} - Stretching
2268 to 2719	NH^{+}_{2} - Asymmetric stretching
1608 to 1502	COO- asymmetric stretching
698	C-Cl – Stretching

RESULTS AND DISCUSSION

FT-IR Analysis (Fig-1):

The grown crystals were subjected to FT-IR analysis with sample prepared with KBr in the palletized form. The FT-IR spectrum of glycine potassium chloride was recorded in the region 4000-400cm^{-1} employing Shimadzu IFS 66V spectrometer. The broad envelope in the high energy region between 3166cm-1 and 2611 cm^{-1} is due to NH3 + stretching vibrations. The region of absorption bands extends to about 2133cm^{-1} due to multiple combination and overtone bands. The prominent band near 2210cm-1 and 2123 cm^{-1}may be assigned to a combination of the asymmetrical NH3 bending vibrations and torsional oscillation of the NH3+group[3]. The NH_3^+ stretching region shows broad bands characteristics of hydrogen bonding. The frequencies of the vibrational mode of the crystal and their assignments are given in the table 1. The absorption peaks characterizing the various functional groups are in very good agreement with those reported in the literature[1,2].

Powder XRD Analysis (Fig-2):

The powder XRD of glycine potassium chloride (GPC) is shown in the fig. The peaks in the fig show the crystalline nature of GPC. Further the peaks are indexed.

UV-Visible Spectrum Analysis (Fig-3):

The optical absorption spectra of Glycine Potassium Chloride crystals (GPC) were recorded in the range 190 – 2500nm using Varian Carry 5E spectrophotometer. The fig shows the UV-Visible spectrum recorded with highly transparent single crystal of GPC of thickness 2mm. It is seen from the absorption spectrum the crystal is transparent in the range 295nm-1355nm without any absorption peak, which is an essential parameter of NLO crystals. The absence of absorption of light in the visible region is the intrinsic property of the amino acids.

Crystal Surface Analysis by SEM (Fig-4,5,6):

Surface analysis of GPC is carried out through JSM 6360 JEOL/EO make. The maximum magnification possible in the equipment is 3, 00, 000 times with a resolution of 3 nm. The surface of the crystal was coated with a thin of carbon to make the sample conducting. From the fig. it is clear that the size of the crystals is 5 microns thick. Further the surface is very smooth without any defects.

NLO Studies:

NLO studies The NLO property of the crystal was confirmed by Kurtz powder technique. The determination of SHG intensity of the crystals using powder technique was developed by Kurtz and Perry[5] .The crystals are ground to powder and packed between two transparent glass slides. The first harmonic output of 1064 nm from a Nd:YAG laser was made to fall normally on the prepared sample with a pulse width of 8 ns. The second harmonic signal generated in the crystal was confirmed from the emission of green radiation by the sample. It is found that the SHG efficiency of the crystal is one and a half times higher than that in the case of KDP, which is in agreement with literature[1,4].

ACKNOWLEDGEMENTS

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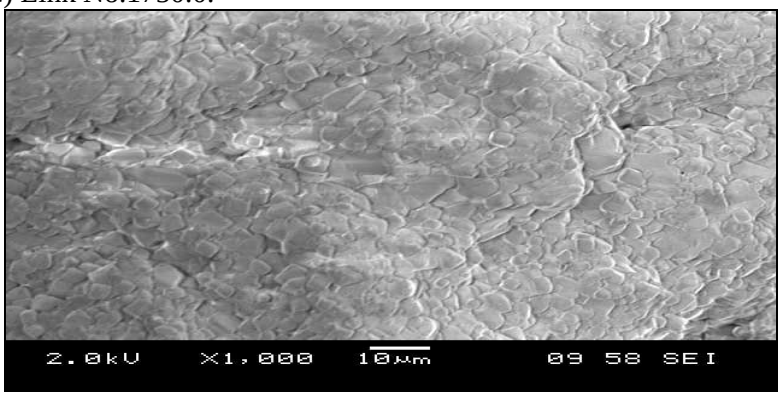

Fig.-4

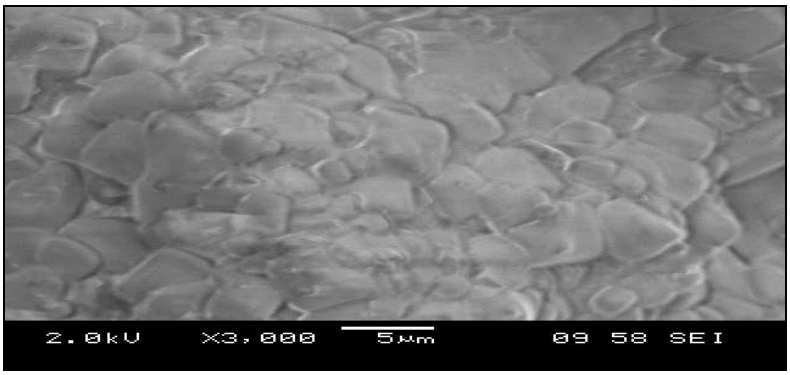

Fig.-5

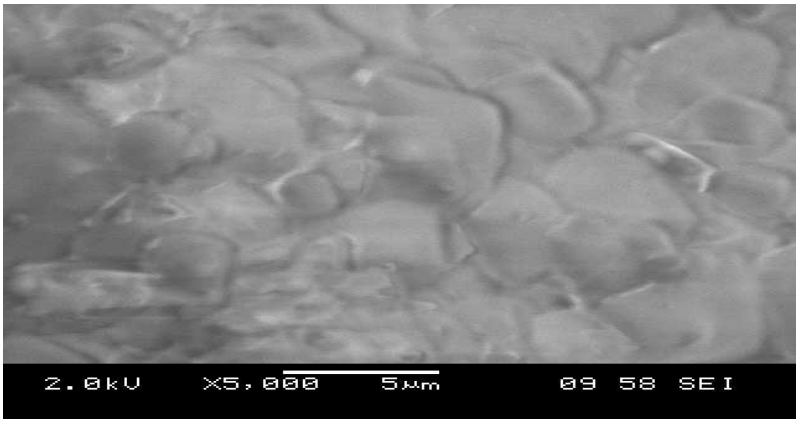

Fig.-6

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"If you have an apple and I have an apple and we exchange these apples then you and I will still each have one apple. But if you have an idea and I have an idea and we exchange these ideas, then each of us will have two ideas."

- George Bernard Shaw