determined lattice parameters for β polymorph is a=5.183Å, b=17.315Å and c= 6.973Å, and they are in line with the literature values [3, 4-8].

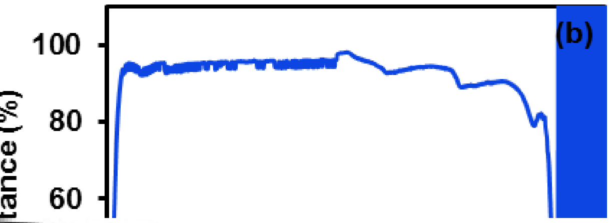
3.2 FTIR spectroscopic analysis

FTIR spectrum of the β-polymorph was recorded and various functional groups present in the crystals were analyzed by identifying their corresponding absorption frequencies. The recorded spectrum of the β polymorph of L-glutamic acid is

O-H bending	930	948

3.3 Optical Transmittance Study (UV-Vis-NIR)

In order to study the optical transmittance of the grown β polymorph, the UV-Vis-Near IR spectrum of the sample is recorded in the wavelength range from 200 to 2000 nm, and is given in Figure 4. The optical transmittance spectrum is important from the application point of view, as the grown crystal or the device fabricated out of the crystal can only be used in the highly transparent region.



In the case of β-L-glutamic acid melting starts at 190.4 °C and ends at 210 °C with a sharp melting band of 19.6 °C. From the TG curve it is observed that the weight loss of 12% occurs between the temperatures 190 °C and 210 °C. This melting indicates that the material is more stable upto the melting. There is no endothermic or exothermic peak observed in the DTA curve below the melting temperature and similarly there is no weight loss observed in TG curve up to the melting temperature. This confirms that the material does not undergo any phase transformation in this temperature range. A broad exothermic peak is observed in the DTA curve of the grown β-L-glutamic acid microcrystal in the range of 450-630 °C, this may be the cross-linking (cure). After this the material decomposes. Results of this study confirm that β-L-glutamic acid crystals have high thermal stability than that of α-L-glutamic acid crystals.

3.5 Differential Scanning Calorimetry (DSC) analyses

Results obtained from the TG-DTA study was further confirmed by DSC analysis. From the DSC curves, the thermal stability of the grown polymorph was recognized. The recorded DSC thermogram of the grown β polymorph is given in Figure 6.

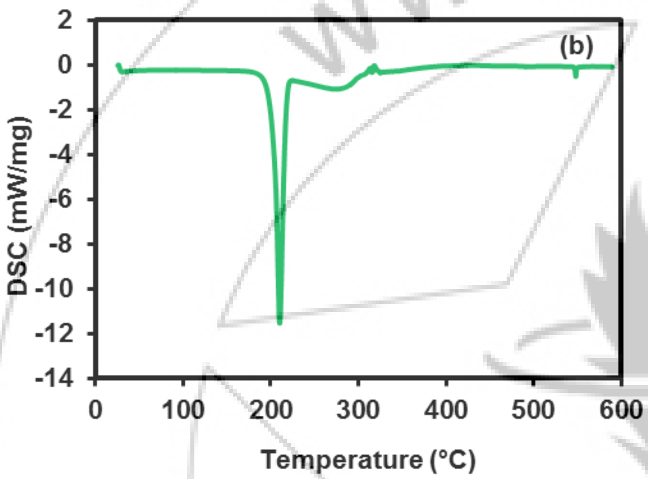


Figure 6: DSC thermogram of the β-L-glutamic acid

The DSC thermogram given in Figure 6 indicates that the grown β polymorph begins its melting at 195.01 °C and ends at 210.24 °C with a sharp melting band of 15.23 °C. From the DSC curve again it is clear that, β-L-glutamic acid polymorph does not have any phase transformation until their melting point and are stable [9].

3.6 Second Harmonic Generation study (SHG)

The second harmonic generation behaviour of the powdered β-L-glutamic acid polymorph was tested by the Kurtz powder technique [10]. Crystalline sample of β polymorphs of L-glutamic acid crystal for which NLO efficiency is to be measured were ground well using mortar and pestle. The ground samples were sieved out for a uniform particle size of 150 μm and used for the experiments. The powder sample is packed in a triangular cell and is kept in a cell holder. The test was carried out using a high-intensity Nd:YAG laser (Quanta-Ray, Spectra physics) source which produces nanosecond pulses (8 ns) of λ =1064 nm light and the energy of the laser pulse was around 350 mJ. Frequency repetition of 10 Hz was passed through the powdered sample. The beam emerging through the sample was focused on to a Czerny-Turner monochromator using a pair of lenses. The SHG behaviour is confirmed from the output of the laser beam having the bright green emission (λ = 532 nm) from the specimen. The detection was carried out using a Hamamatsu R-928 Photomultiplier tube. The signals were captured with an Agilent infiniium digital storage oscilloscope interfaced to a computer. The recorded SHG signal of the grown β polymorph is given in Figure 7.

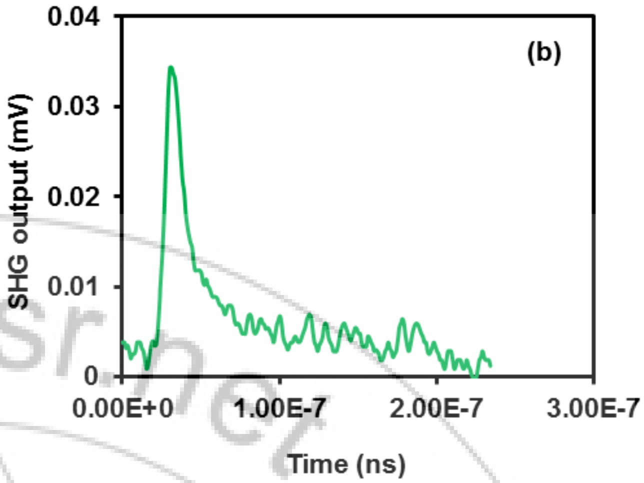


Figure 7: SHG signal of β-L-glutamic acid

The second harmonic signal of about 0.035 mV/pulse was obtained for the crystalline powder of the β-L-glutamic acid (stable form) an input energy of 350 mJ/pulse as shown in Figure 7. This result indicates that the grown β-L-glutamic acid polymorph have the ability to generate SHG for the given laser input. The SHG energy conversion efficiency of β-L-glutamic acid polymorph is less than that of the standard inorganic KDP. The SHG signal of 0.564 mV/pulse was obtained from the standard inorganic KDP crystal for the same input energy.

4. Conclusion

Stable β polymorph of L-glutamic acid was grown by slow evaporation method. The XRD data obtained from the pattern confirm that the polymorph belong to the orthorhombic crystal system with space group $P2_12_12_1$. FTIR spectra of the β-polymorphs were recorded and various functional groups present in the crystals were analyzed by identifying their corresponding absorption frequencies. From UV-Vis-NIR we can confirm the optical transparency of the grown crystal. TG/DTA and DSC analysed the thermal stability of the grown crystals. Second harmonic generation provides an opportunity for the application of crystals in photonic industry for future generation.

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