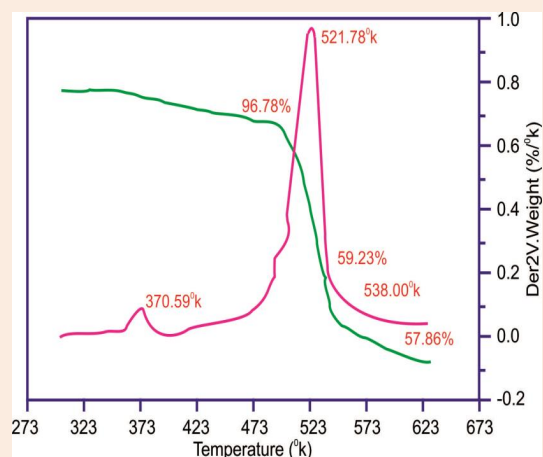


Research Article

Thermal Decomposition of Ferroelectric Glycine Potassium Sulphate Crystal

I.J.Patil^{1,*}, M.S.Shinde², P.P.Jagtap¹, P.B.Ahirrao³ and R.S.Patil¹¹Dept. of Physics, P. S. G. V. P. M'S Arts, Science & Commerce College Shahada, Dist- Nandurbar²Dept. of Physics, M.J.M. Arts, Commerce & Science College Karanjali (Peth), Dist-Nashik - 422 208 (M. S.) India³S.V.S's Dadasaheb Rawal College, Dondaicha, 425408, (M. S.) India**Abstract**

Glycine Potassium Sulphate ($\text{NH}_2\text{CH}_2\text{COOH}\cdot\text{K}_2\text{SO}_4$) GPS-I & GPS-II crystal were grown from aqueous solution by slow evaporation technique at room temperature. The molecular weight proportion of Glycine and potassium sulphate in GPS-I it is 1:1 Ratio and in GPS-II it is 3:1 ratio. These crystals in powdered form were subjected to thermal analysis on general V₂.2A DUPONT 9900 system with DSC cell attachment. It is observed that the decomposition temperature for GPS-I in TG/DTG curve is 538⁰k with rate 278⁰k/min & in DSC curve it is 513.48⁰k with rate 283⁰k/min. For GPS-II crystal the decomposition temperature is 544.99⁰k with rate of 278⁰k/min. in TG/DTG curve is 513⁰k with rate 283⁰k/min & in DSC curve. The small variation in TG/DTG is due to different heating rate confirming characteristics decomposition temperature around 513⁰k also shown by DSC data. The loss in weight decreases slightly from 1:1 to 3:1 which is due to loss of water molecules from Glycine. DSC studies reveal no ferroelectric transitions in the temperature range from room temperature to 593⁰k. The heat flow increases from GPS-I to GPS-II. All the reactions are exothermic. The results are also compared with Glycine potassium fluoride, G₁KF and G₃KF crystals, the implications are discussed.



Keywords: Glycine Potassium Sulphate, GPS-I, GPS-II, Thermal analysis, TG/DTG and DSC

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Introduction

Thermal analysis is the measurement of changes in the physical properties of a substance as a function of temperature while the substance is subjected to a controlled temperature programmed. It is one of the methods used for characterization of material. The study of the effect of heat on materials has been long history followed by the development of thermometry and calorimetry^{1,2}. Recent experiment on the effect of heat on materials have becomes more controlled and quantitative, involving development of sophisticated analytical balances. Commercially available equipment has resulted in thermal analysis being an extremely active field with application in numerous directions.

A complete modern thermal analysis instrument measures temperature of transition, weight losses in materials energies of transition, dimensional changes, modulus and viscoelastic properties. There has been considerable interest in thermal analysis and also been suggested³ that it should be extended to allow rapid heating of temperature at some elevated temperature followed by measurement of the property⁴ with time under isothermal condition.

Literature survey indicates that some experimental work were carried out and reported on very few organic solids like TGS^{5, 6} class of ferro-electrics^{7,8}. With this view Glycine potassium sulphate GPS-I and GPS-II crystal with different proportion of Glycine and Potassium sulphate were grown⁹⁻¹¹. In the present paper characterizations¹²⁻¹⁴ of titled crystal with help of thermal analysis is discussed.

Experimental:

Glycine potassium sulphate ($\text{NH}_2\text{CH}_2\text{COOH}\cdot\text{K}_2\text{SO}_4$), GPS-I and GPS-II crystal were grown from aqueous solution in distilled water by slow evaporation technique at room temperature. The molecular weight proportion of Glycine and potassium sulphate in GPS-I is with 1:1 ratio and GPS-II is with 3:1 ratio.

A good transparent crystal was obtained within five to seven weeks. Crystals in powdered form were subjected to thermal analysis namely thermogravimetry (TG), derivative thermogravimetry (DTG) and differential scanning calorimetry (DSC) between temperature ranges from room temperature to 673°K in inert nitrogen atmosphere at the rate of 278°K and 283°K/min. Platinum sample holder was used for TG and copper for DSC.

All the sample were weighted on METTLER make digital balance while general V2.2A DUPONT 9900 system with DSC cell attachment was employed for above thermal analysis.

Observation and Result:

Thermo gravimetric analysis (TGA /DTG and DSC) for both GPS-I and GPS-II are shown in figure 1 to 4.

During the observation of physical properties, it was seen that the sample undergoes decomposition to brown color. The quantitative measurement of change in masses brought about by heating the sample under controlled temperature is given TGA /DTG curve. Table-I shows corresponding decomposition temperature for GPS and GKF crystal obtained by TG /DTG and DSC curves.

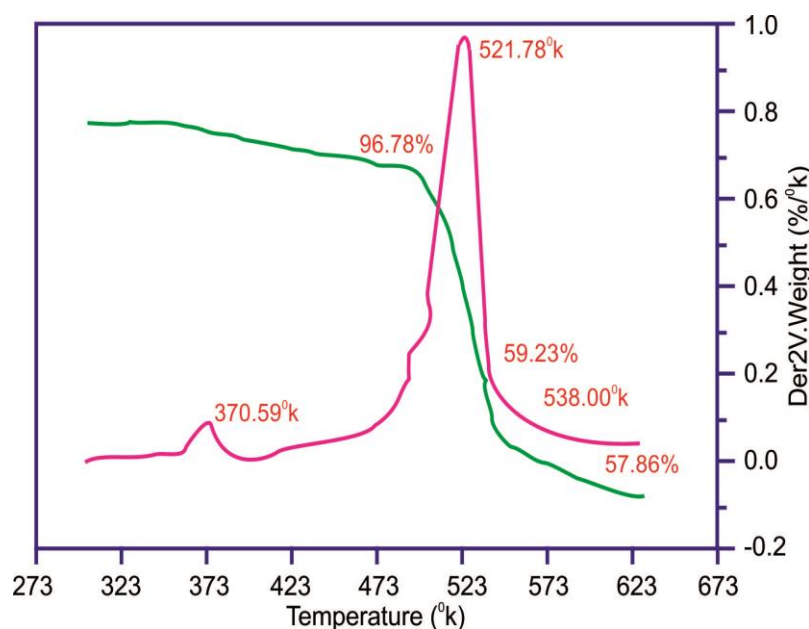


Figure 1 TGA DTG of GPS-I

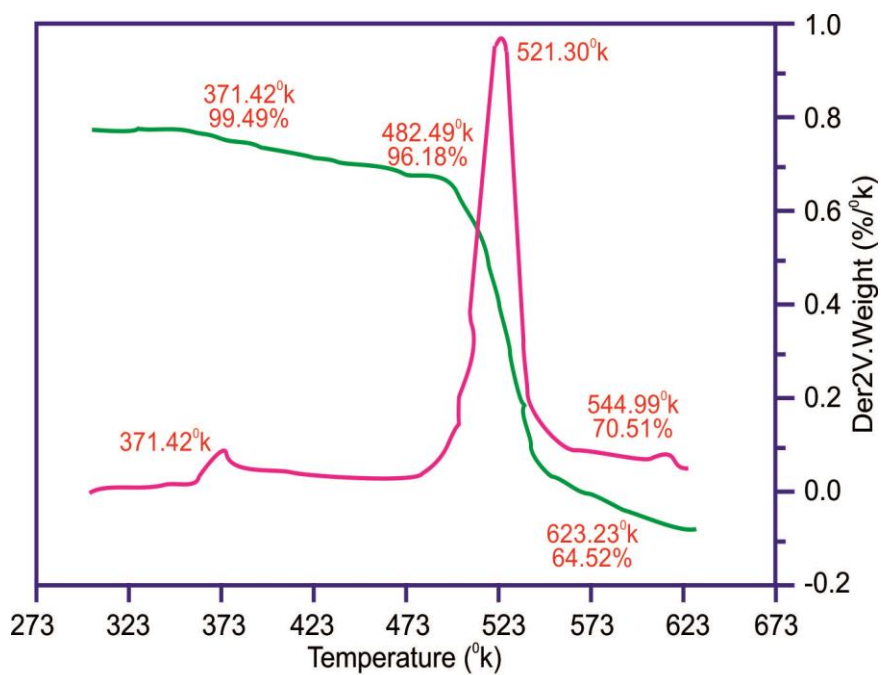


Figure 2 TGA DTG of GPS-II

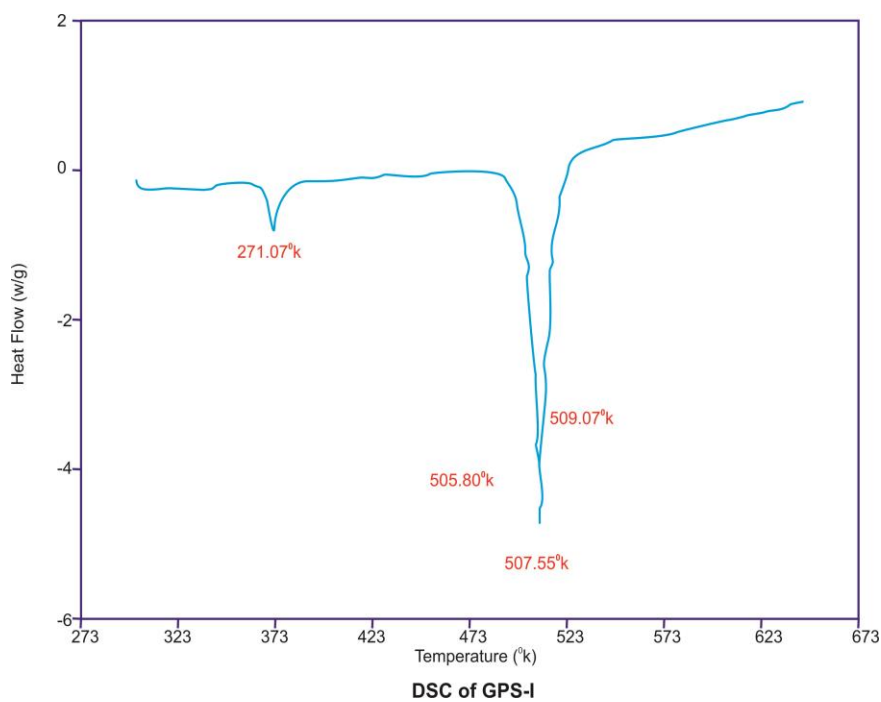


Figure 3 DSC of GPS-I

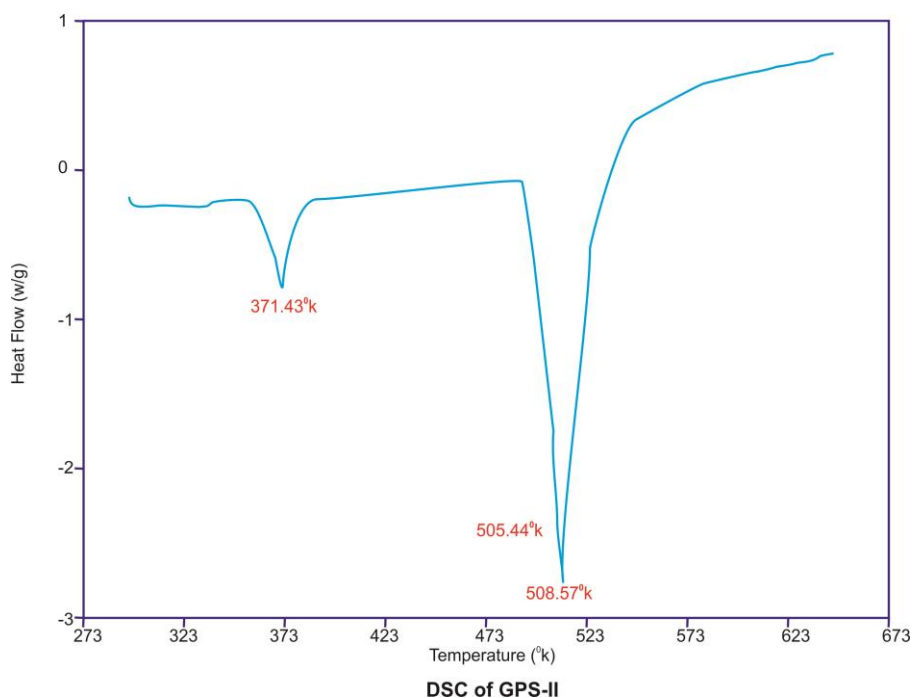


Figure 4 DSC of GPS-II

Table 1 Decomposition temperature from TGA /DTG and DSC

Ob. No	Compound	Decomposition TGA		Temperature DSC	
		°K	Rate °K/Min	°K	Rate °K/Min
1	GPS-I	538	278	513.48	283
2	GPS-II	544.99	278	513.48	283
3	GKF	538	278	523	283

The small variation of about 7°K in GPS and 15 °K in GKF is obtained due to different heating rate. The decomposition temperature of GPS series crystal is found 513°K and that of GKF series is found at 523°K. The DTG peaks at about 0.98%/°K and 1.7%/°K in GKF.

Discussion

It is observed that decomposition temperature showing decomposition rate loss is less which can be understood as potassium sulphate and potassium fluoride are ionic. The strength of bond between Glycine potassium sulphate and potassium fluoride is more. Bond energy is more therefore rate of decomposition¹²⁻¹³ is less.

DSC studies reveal no ferroelectric transition¹⁴ in temperature range from room temperature to 573°K. all the reaction are exothermic exhibition sharp isotherms around 513°K in GPS and 523°K in GKF series. The heat flow is seen to increase as we go from 1:1 to 3:1 in both GPS and GKF series.

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