ORIGINAL RESEARCH PAPER

Physics

KEY WORDS: TGS Crystal, Frequency, Dielectric constant, A C conductivity.

SYNTHESIS AND DIELECTRIC PROPERTIES OF L-TYROSINE AMINO ACID DOPED TGS CRYSTALS

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ABSTRACT

The effect of doping the pure TGS crystal with L-Tyrosine amino acid at 10 wt% weight percentage. The crystals are grown at room temperature by using "Slow evaporation method". The prepared crystals are used to study the dielectric properties such as dielectric constant and AC conductivity as a function of frequency ranging from 50 Hz - 5 MHz at room temperature.

INTRODUCTION

Triglycine sulphate (TGS) crystal is a useful ferroelectric material founded in 1956 and has low dielectric constant and large pyroelectric coefficient. The Triglycine sulphate, (NH2CH2COOH)3 H2SO4, crystal is considered as one of the potential materials It finds applications in the fabrication of pyroelectric vidicon tubes, capacitors, transducers, sensors and also it is used in the infra red detection techniques as commercial product, UV tunable laser, second harmonic generation, and pyroelectric infrared sensors due to its high pyroelectric coefficient, optical transmission, and reasonably low dielectric constant [1]. It is a hydrogen bonded ferroelectric crystal having a typical second-order phase transition at Curie temperature of 49 C [2-3].Below the Tc, TGS possesses the polar point symmetry of group 2 of monoclinic system, spontaneous polarization arises along the b-axis and above Tc, it possesses the non-polar point group 2/m of the monoclinic system [4-5]. have studied the dielectric properties of TGS crystals admixture with L-tyrosine amino acid and they have found that, the ferroelectric phase transition occurs at 49°C and there was no change in the transition temperature due to dopant addition.

Experimental methods

Synthesis and crystal Growth: Triglycine Sulphate [NH2CH2-COOH)3H2SO4] was synthesized from glycine and sulpheric acid in the molar ratio 3:1. analar grade sulpheric acid is added to an aqueous solution of glycine in stoichometric proportions and this reaction is carried at room temperature. Calculation of stoichometric proportion is shown below.

Reaction:-

3(NH2CH2(OOH)+H2SO4 (NH2CH2COOH)3H2SO4
Glycine + Sulphuric acid Triglycine Sulphate
Mol-weight of glycine: (NH2CH2COOH) =75.07
Mol-weight of sulphuric acid (H2SO4) = 98.08
Mol-weight of TGS:
(NH2CH2COOH)3 H2SO4=3x75.07+98.08=323.29
0.1x (Stoichometric Proportion)
Amount of glycine = 0.1 x 225.21=22.521 gm
Amount of sulphuric acid = 0.1 x 98.08 = 9.808gm

The synthesized salt was again dissolved in triple distilled water and then recrystallized by natural evaporation process. This process was repeated three times to improve the purity of the material. The seed crystals of pure TGS were prepared by natural evaporation method. Good quality and defect-free seed crystals were suspended with nylon thread within the solution of the beaker to grow bulk-size crystal. To obtain doped TGS crystal, 10 wt% of L-Tyrosine was added to the TGS saturated solution. Highly transparent and fullfaced crystals were obtained within 4 weeks.

Result and Discussion

a) Dielectric constant: The dielectric properties such as dielectric constant of a pure TGS crystals and amino acid (L-Tyrosine) doped with TGS Crystal as a function of frequency over the range (50 Hz – 5 MHz) at room temperature for different thicknesses.

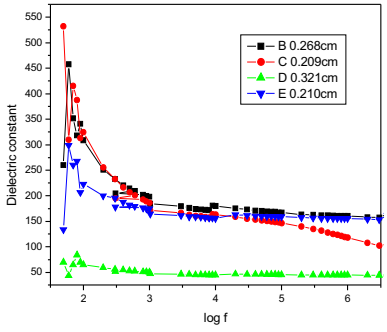

Figure 1: Plot of fVs (ε') for of TGS crystal.

In Fig 1 we observed that at frequency 60 Hz and 90 Hz we observed the dielectric peak values 457.803 and 341.271 respectively for TGS crystal of thickness 0.268 cm. The dielectric constant after these frequencies is going to decrease exponentially over the frequency range 90 Hz – 1 KHz and afterwards it remains constant for higher order of frequencies.

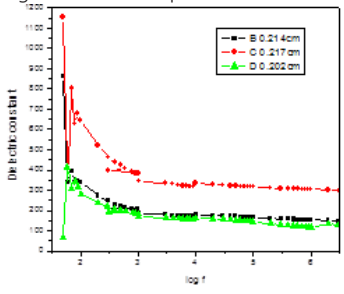

Figure 2: log f Vs (ε) with 10% of L-Tyrosine amino acid.

Further, we have observed the dielectric properties such as dielectric constant of an amino acid (L-Tyrosine) doped with TGS Crystal as a function of frequency for different thicknesses. In Fig 2 we observed that at frequency 50 Hz and 70 Hz we observed the dielectric peak values 862.009 and 394.739 respectively for 10 % doped amino acid TGS crystal of thickness 0.214cm. The dielectric constant after these frequencies is going to decrease exponentially over the frequency range 90 Hz – 1KHz and afterwards it remains constant for higher order of frequencies

b) A C conductivity: In Figure 3.and Figure 4 we observed that as the frequency increases the conductivity TGS crystal and TGS crystals doped with 10 wt % of amino acid at different thickness is

remains constant up to frequency 10 KHz, further the conductivity increases gradually we observed the conductivity peak value at 525.33 for 2MHZ, for TGS crystal of thickness 0.268 cm. the peak value of conductivity is observed at 40 MHZ for thickness 0.217cm

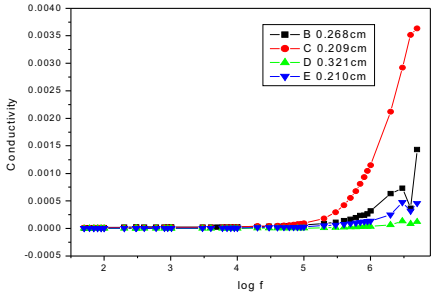

Figure 3: Plot of Frequency Vs σac of TGS crystals.

The thickness of the TGS crystal with amino acid increases the A C conductivity also increases.The conductivity after these frequencies is going to increases exponentially over the frequency range 10 KHz –5 MHZ. The thickness of the TGS crystal increases the conductivity decreases.

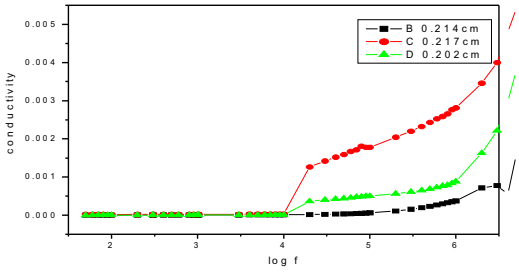

Figure 4: Plot of log f Vs σac with 10% of L-Tyrosine amino acid.

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