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A Review of physical and chemical properties of Glycine crystals family

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Abstract : The semi-organic material non-linear optical material has a wide scope of utilization in optical communication, information handling, and photonics. In this survey, a group of glycine complexes was investigated. These complexes display the property, for example, NLO, negative photoconductivity, and low dielectric loss make this material appropriate for optoelectronic gadget fabrications. Single crystals of semi-organic nonlinear optical material glycine family crystals have been synthesized by slow evaporation technique from aqueous solutions at room temperature. Thus, the grown single crystals were thoroughly characterized by various instrumental methods for the crystallinity and crystal structure, bonding, optical nature, thermal stability, microhardness, etc. Further, the powder second harmonic generation (SHG) efficiency was measured by Kurtz and Perry powder technique using Nd: YAG laser.

Key Words : semi-organic material; Glycine family, single crystals and SHG.

1. Introduction

Nonlinear optics (NLO) is the most trust regions which have wide application in the electronic industry. The new nonlinear optic material is an incredible interest for the gadget manufacturers which is the most encouraging material for the youthful analyst when light is occurrence on the material the material shows the property of nonlinearity as per the light wonder, which displays second harmonic generations with the communication of light. This nonlinear optic material has a wide modern application in the field of electronic communication and calculation [1,2]. In the present setting of interest for continuous control and correspondence, NLO materials assume an essential part in the creation of electro-optic modulators, which convert an electric sign to an optical one for transmission through a fiber optic link. The use of NLO materials incorporates fiber optics, image applications utilizing photorefractive crystals, frequency multipliers and

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mixers, parametric oscillators, and optical switches. There has been a wide inquiry as of late to recognize appropriate materials for such cycles on account of the viability in creating new frequencies from existing lasers through consonant age and whole and distinction frequencies generation. Normally, these materials should (i) be impervious to optical harm, (ii) have high mechanical hardness, (iii) display great warm and substance strength, (iv) be fit for being filled invaluable size, and (v) have the fitting stage coordinating properties [3-6].

2. Glycine family of NLO crystals

Glycine ($C_2H_5O_2N$) has the most reduced molecular weight among every amino acid. Glycine, a white translucent amino acid, is found as a constituent of numerous proteins. It is a subsidiary of acidic acid. It is otherwise called amino acetic acid. It is the least difficult one among twenty common amino acids, speaking to roughly 33% of collagen structures. It has been generally utilized in crystal designing. In contrast to other amino acids, it has no asymmetric carbon and it is optically idle. That is, it doesn't have D-and L-stereoisomer. It is the main protein shaping amino acid without a center of chirality. It exists as zwitterions in the arrangement and a strong state. Even though there are various reports on this compound, the phenomenal qualities of glycine family crystals power the investigation to perform further examinations on its properties. However, only those complexes of glycine, which crystallizes in a non-centrosymmetric structure, are expected to exhibit nonlinear optical second harmonic generation [7,8]. The primary point of this work is to investigate and reveal insight into anisotropic nature just as the phase-matching properties. The vast majority of the buildings of amino acids are the nonlinear optical (NLO) materials which have the assortments of uses regarding optical correspondence, optical figuring, optical information preparing, and photonics. Amino acids and inorganic materials like cadmium sulfate, cadmium chloride, zinc sulpfate, zinc chloride and so forth can be consolidated to frame amino corrosive based metal-organic crystals and these are additionally called as the semi-organic NLO materials and they have both the upsides of organic amino acids and inorganic metal complex salts. To improve the physical-compound properties of these crystals, organic materials like glycine, thiourea Single crystals of unadulterated and glycine or thiourea were developed by solution technique, and the developed crystals were characterized, and different physical and chemical properties were considered.

3. Material Synthesis

For developing the crystal, analytical grade synthetic compounds of glycine family crystals blended in double deionized water mixed by methods for magnetic stirrer for getting uniform focus at the surrounding temperature [9,10]. The supersaturated solution was filtered by Whatman filter paper and permitted to evaporate gradually at room temperature over a time of the month, which yielded optically great quality crystals by the cycle of nucleation and grain development. The morphology of glycine family crystals was studied in order to assess its growth facets. The good quality single crystals were subjected to physicochemical characterizations.

4. Results and discussions

4.1 Glycine Thiourea(GT)

Glycine Thiourea was developed utilizing the slow evaporation technique [11]. The single crystals XRD uncovers that crystal is a monoclinic crystal system and the lattice esteems are *a=5.30Å, b=11.90 Å, c = 5.85 Å, v= 370* A^3. The UV investigation uncovers that the cut off wavelength is around 260 nm, the optical absorption study uncovers that the optical bandgap of the crystal is 4.77ev, the dielectric examines shows that the dielectric loss is least for this crystal. AC conductivity study shows that actuation energy of Glycine Thiourea is calculated to be 0.130 eV.

4.2 Zinc Thiourea Chloride(ZTC)

Zinc Thiourea Chloride was developed utilizing a slow evaporation technique [12]. The single crystals XRD uncovers that crystal is an orthorhombic crystal system and the lattice esteems are *a=5.89Å, b=12.66 Å,c = 12.91 Å, v= 962.99* A^3. The UV analysis uncovers that the cut off wavelength is around 290 nm, optical absorption study uncovers that the optical bandgap of the crystal is 4.37ev, Absorption coefficient (α), extinction coefficient (k), refractive index(n), electric susceptibility (χ_c) were determined to dissect the optical property, the dielectric studies shows that the crystal has a low value of the dielectric loss, the electronic properties of crystal-like plasma energy, Penn gap, Fermi energy, and electronic polarizability have likewise been determined.

4.3 L- Glycine Thiourea

L-Glycine Thiourea was developed utilizing the slow evaporation technique [13]. The single precious stones XRD uncovers that crystal is an orthorhombic crystal system and the lattice esteems are *a=5.52Å, b=7.72 Å ,c = 8.63 Å, v= 368* A^3. The various functional group and their vibrational interaction of the developed crystal were confirmed by FTIR investigation. The UV analysis uncovers that the cut-off wavelength is around 200 nm, the assessed SHG efficiency found to be 0.6 occasions of KDP crystals, the crystal has a positive refractive, and susceptibility (χ_c) found to be 4.68×10^{-4} esu.

4.4 BisThiourea Nickel Bromide(BTNB)

BisThiourea Nickel Bromide was developed utilizing the slow evaporation technique [14]. The single crystals XRD uncovers that crystal is an orthorhombic crystal system and the lattice esteems are *a=6.132Å, b=8.096 Å,c = 9.11 Å*. The UV analysis uncovers that the cut off wavelength is around 250 nm, the optical absorption study uncovers that the optical bandgap of the crystal is 4.35ev, the assessed SHG efficiency found to be 1.6 occasions of KDP crystals, the refractive record was found to be 1.726, the estimation of electric susceptibility (χ_c) was found to be 0.193, the estimation of real (ε_r) and imaginary(ε_i) dielectric constant was found to be 1.62 and 7.532. Ac conductivity study was performed and the activation energy was calculated, photoconductivity estimations affirm the property of negative photoconductivity of the crystal, etching studies affirm the engraving pits on the surface of the specimen.

4.5 Glycine Zinc Sulfate (GZS)

Glycine Zinc Sulfate was developed utilizing a slow evaporation technique [15]. The single crystals XRD uncovers that is an orthorhombic crystal system and the lattice esteems are *a=8.52Å, b=8. 64 Å ,c = 12.50 Å*. The UV analysis uncovers that the cut off wavelength is around 230 nm, the optical absorption study uncovers that the optical bandgap of the crystal is 5.40ev, the assessed SHG efficiency found to be 1.2 occasions of KDP crystals, the refractive index was found to be 1.587, the estimation of electric susceptibility (χ_c) was found to be 0.147, the estimation of real (ε_r) and imaginary(ε_i) dielectric constant was found to be 1.523 and 7.802, the dielectric constant and loss were studied at different temperature and frequency, photoconductivity estimations uncovers the property of negative photoconductivity of the crystal, etching studies affirm the etching pits on the surface of the specimen.

4.6 Glycine Sodium Nitrate (GSN)

Glycine sodium nitrate was developed utilizing the slow evaporation technique [16]. The single crystals XRD uncovers that crystal is an orthorhombic crystal system and the lattice esteems are *a=14.323 Å, b=5.2573 Å, c = 9.1156 Å*. The UV analysis uncovers that the cut off wavelength is around 310 nm, the optical absorption study uncovers that the optical bandgap of the crystal is 4.0ev, the assessed SHG efficiency found to be 2 times of KDP gems, the refractive index was found to be 1.510, the optical examination shows a high estimation of extinction coefficient(K) and reflectivity (R), the estimation of the microhardness test uncovers that Vickers hardness increments with increment in the load, the dielectric loss shows low dielectric loss, photoconductivity estimations confirm the property of negative photoconductivity of the crystal.

4.7 Benzoyl Glycine Crystals (BGC)

Benzoyl Glycine Crystals were developed utilizing the slow evaporation technique [17]. The single crystals XRD uncovers that crystal is an orthorhombic crystal system and the lattice esteems are *a=8.874Å, b=10.577Å, c = 9.117 Å*. The dielectric constant of Benzoyl Glycine crystal emphatically relies upon temperature just as the frequency of the applied AC field, given the frequency of the applied field is in lower frequency scope of 50 HZ to 1KHZ, the dielectric constant declines with expanding frequency range 1 kHz-5 MHZ, the conductivity remains nearly the equivalent in the temperature scope of 35 °C - 135°C comparing to a recurrence of 5 MHZ. The conductivity increments with temperature till 135°C.

5. Summary

The glycine group of NLO crystals was concentrated by methods of slow evaporation technique which hushes up productive strategy in the planning of NLO crystals, this audit article sums up significant physical properties like lattice parameters, UV optical cut off wavelength, photoconductivity, microhardness, bandgap, second harmonic generation parameters well reasonable for modern and mechanical application are listed in the Table1.

Table1: Important properties of Glycine crystals

Name of The Compound	Lattice Parameter	SHG Parameter	UV Optical Cut Offf	Photo Conductivity	Microhardness	Band Gap	AC Conductivity	Electronic Properties	Optical Properties	Xrd Analysis
Glycine Thiourea(GT)	*a=5.30Å , b=11.90 Å ,c = 5.85 Å, v= 370 A*^{3}		260 nm	Negative photoconductivity		4.7eV	0.130eV			
Zinc Thiourea Chloride(ZTC)	*a=5.89Å , b=12.66 Å ,c = 12.91 Å, v= 962.99 A*^{3}		290nm	Negative photoconductivity		4.30eV		Plasma energy17.87ev Peen gap(Ep)3.32 eV E_F 13.64 Electronic polarisibility 5.97x10-^{23}cm^3		
L- Glycine Thiourea	*a=5.52Å , b=7.72 Å ,c = 8.63 Å, v= 368 A*^{3}	0.6 times of KDP crystal	200nm						n=1.24 χ^3=4.68x 10-^{4}esu	Crystal size =54.87nm, Bond length=3.3011
BisThiourea Nickel Bromide(BTNB)	*a=6.132 Å, b=8.096 Å ,c = 9.11 Å*	1.6 times of KDP crystal	250nm	Negative photo conductivity	Microhardness increasing with an increase in load	4.35eV			n=1.726 χ_c=0.193 ε_r=1.62	
Glycine Zinc Sulfate (GZS)	*a=8.52Å , b=8. 64 Å ,c = 12.50 Å*	1.2 times of KDP crystal	230nm	Negative photo conductivity	Microhardness increasing with an increase in load	5.40eV			n=1.587 χ_c=0.147 ε_r=1.523 ε_i=7.802	
Glycine Sodium Nitrate (GSN)	*a=14.323Å, b=5.2573 Å ,c = 9.1156 Å*	2 times of KDP crystal	310nm	Negative photoconductivity	Microhardness increasing with an increase in load	4.0eV				

Benzoyl Glycine Crystals(BGC)	*a=8.874 Å, b=10.577Å ,c = 9.117 Å*									

6. Conclusion

NLO glycine family crystals were contemplated and it is obvious that a glycine group of single crystals is appropriate for mechanical application. This audit article pays the route for the researchers to proceed with their exploration for different mixes to develop NLO single crystals for an optoelectronic gadget which will be a promising expected territory for NLO crystals.

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