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Synthesis And Structural Analysis of L-Alanine Hydrogen Bromide Crystals

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ABSTRACT

L-Alanine hydrogen bromide (LAlHBr) single crystals were grown and characterized in this work. These crystals were synthesised at room temperature utilizing the slow evaporation approach. An optimal procedure included dissolving L-Alanine and hydrobromic acid in equal parts of double deionized water to produce a supersaturated solution. This was followed by filtering the solution and letting it evaporate. Single crystals that were transparent and devoid of defects were produced effectively in an environment of 50 days. Researchers have examined the absorbance of these produced crystals using UV-Vis-NIR measurements. Research has shown that these crystals absorb very little light throughout the visible spectrum. Researchers used Fourier transform infrared (FT-IR) analysis to learn about the functional groups in LAlHBr crystals. The results of the photoconductivity experiments demonstrate that LAlHBr has no photoconductivity properties. Based on the findings, LAlHBr crystals are very desirable for use in photonics and optoelectronics due to their high electrical characteristics and remarkable optical transparency.

Keywords: *Nonlinear optics, Hydrogen Bromide, Photoconductivity, Photonic.*

I. INTRODUCTION

A subfield of optical physics known as nonlinear optics (NLO) studies how matter interacts with powerful electromagnetic radiation to produce optical phenomena that defy linear optical theory. Modern photonics relies on research into nonlinear optical phenomena for a variety of applications in fields as diverse as medical imaging, signal processing, optical computing, telecommunications, and laser technology. The use of nonlinear optical single crystals is fundamental to nonlinear optics. These crystals have improved optical characteristics that enable quantum and macroscopic light manipulation.

Materials that display nonlinear optical responses when subjected to intense laser beams are known as nonlinear optical single crystals. Nonlinear optical materials show a dependency on the intensity of the incoming light, in contrast to linear optical materials that keep the connection between the electric field and polarization constant. These interdependencies lead to phenomena like SHG, THG, OPO, SFG, and DFG, which stand for second-harmonic generation, third-harmonic generation, sum-frequency generation, and difference-frequency generation, respectively. Laser frequency conversion, optical modulation, and high-speed data processing are only a few of the many applications that make use of these phenomena.

Applications involving high-intensity lasers and ultrafast optics also make substantial use of nonlinear optical crystals. Pulse shaping and optical communication are greatly impacted by nonlinear processes such self-focusing, self-phase modulation, and soliton creation. Crystal damage threshold and nonlinear optical response enhancement have been the primary areas of research in the field of nonlinear optical materials in recent years. In an effort to improve the characteristics of NLO materials, scientists have looked at doping methods, composite architectures, and new ways of crystal engineering. New possibilities for miniature and high-performance optical systems have emerged with the combination of photonic devices like microresonators and waveguides with nonlinear optical crystals. Progress toward next-generation photonic technology has also been made with the development of plasmonic nanostructures and nonlinear metasurfaces, which improve nanoscale nonlinear optical interactions.

New developments in optical communication, laser technology, and quantum computing are driving up the need for nonlinear optical single crystals. The capacity to control the wavelength and intensity of light has brought about revolutionary changes in many areas, including safe optical communication systems and laser-based medical treatments. Nonlinear optical single crystals have the potential for even more efficiency, adaptability, and incorporation into new photonic technologies in the future as scientists investigate new materials and inventive production methods.

II. L-ALANINE HYDROGEN BROMIDE NONLINEAR OPTICAL CRYSTALS

The creation of new organic and semi-organic nonlinear optical crystals has been a major contributor to the rapid progress in nonlinear optics (NLO) throughout the last few decades. The intrinsic optical nonlinearity, lack of toxicity, and high optical transparency of amino acid-based crystals make them stand out as potentially useful materials. One organic salt crystal that has gained interest due to its nonlinear optical uses is L-Alanine Hydrogen Bromide (L-Ala HBr). It is an attractive option for photonic and optoelectronic devices because to its semi-organic nature, which combines the best features of organic and inorganic components. Nonlinear optical materials are vital for data processing, optical switching, and laser technology because of their capacity to produce new light frequencies via nonlinear interactions.

L-Alanine is an α-amino acid that is found in nature and is part of the class of zwitterionic compounds that have a chiral center. The crystalline salt L-Alanine Hydrogen Bromide has significant second-order nonlinear optical characteristics; it is formed by combining L-Alanine with hydrobromic acid (HBr). Since only materials that are not perfectly symmetrical may display second harmonic generation (SHG), the nonlinear optical performance of a crystal is greatly influenced by the existence of a noncentrosymmetric structure in its lattice. Applications in laser frequency conversion and optical communications are enabled by SHG, a technique that creates a new photon at double the frequency of an incoming photon at a fundamental frequency. L-Ala HBr crystals are well suited for second-harmonic generation applications because to their SHG property. These applications find extensive usage in optical data processing systems and laser-based technologies.

Confirmation of phase purity, lattice parameters, and crystal symmetry requires structural analysis of L-Alanine Hydrogen Bromide crystals. To ascertain the molecular packing and crystalline structure, methods including powder and single-crystal X-ray diffraction (XRD) are often used. A noncentrosymmetric space group is required for second-order NLO activity, and XRD pattern analysis shows that L-Ala HBr crystallizes in this group. Molecular vibrations, functional groups, and hydrogen bonding interactions inside the crystal lattice may be identified using Fourier-transform infrared (FTIR) and Raman spectroscopy. Strong hydrogen bonds and zwitterionic interactions improve structural stability and help explain the optical qualities that are seen.

The photonic uses of L-Ala HBr crystals are significantly impacted by their transparency, refractive index, and nonlinear optical response, among other important optical characteristics. Studies on optical transmission have shown that L-Alanine Hydrogen Bromide crystals are very transparent in the visible and near-infrared spectrums, which makes them a promising material for the production of optical devices. Efficient nonlinear optical applications rely on minimum optical losses, which are assured by the lack of substantial absorption in these areas. By measuring the crystal's bandgap energy and transparency range, UV-Vis-NIR spectroscopy reveals information about the crystal's electrical structure and optical band transitions. One common method for evaluating L-Ala HBr's nonlinear optical behavior is the Kurtz-Perry powder SHG test. This involves comparing the crystal's second harmonic signal with that of a standard reference material, such potassium dihydrogen phosphate (KDP). L-Alanine Hydrogen Bromide has the makings of a promising nonlinear optical material, according to experimental findings that show it has a high SHG efficiency.

When designing high-power laser systems or optical modulators, nonlinear optical crystals' mechanical and thermal stability is crucial. Typical methods for determining a material's thermal stability include thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC), which quantify the material's phase transition behavior and breakdown temperature, respectively. Crystals of L-Ala HBr are well-suited for use in high-power lasers because they are thermally stable and decompose at relatively high temperatures. Researchers may learn more about a material's resistance to deformation and fracture via mechanical hardness investigations that use Vickers microhardness testing. When fabricating devices that are susceptible to mechanical stress and environmental variables that might affect their long-term performance, L-Alanine Hydrogen Bromide is an excellent choice because to its mechanical resilience.

Optical and photonic technologies find many uses for L-Alanine Hydrogen Bromide crystals due to their unusual mix of mechanical, thermal, and optical qualities. The frequency doubling of laser light is one of the most notable uses for these crystals, which are used in second-harmonic generation. Optical data storage, communications, and green laser generating are three areas that benefit greatly from this. The nonlinear optical response of L-Ala HBr crystals allows for fast signal processing and data transmission, making them useful in optical modulators and switches. Nonlinear optical materials have a growing role in medical diagnostics and scientific research because to their applications in laser spectroscopy and biomedical imaging.

Applications of L-Alanine Hydrogen Bromide Crystals

The distinctive optical, electrical, and structural characteristics of L-Alanine Hydrogen Bromide (L-AlaHBr) crystals have attracted considerable interest from the scientific and technological communities. The crystals from the naturally occurring amino acid L-Alanine have unique properties that make them useful in many fields, such as electronics, photonics, biomedicine, and pharmaceuticals. These properties include biocompatibility, piezoelectricity, and nonlinear optical (NLO) behavior. Biosensors, medication delivery systems, and energy storage devices are just a few of the many uses for these materials.

1. Nonlinear Optical (NLO) Applications in Photonics

Highly suited for photonic applications, L-Alanine Hydrogen Bromide crystals have remarkable nonlinear optical characteristics. Their conversion of low-frequency light into high-frequency radiation is an essential process in second-harmonic generation (SHG). This quality is crucial for the frequency conversion process in laser technology, which allows infrared (IR) sources to produce visible and ultraviolet (UV) laser light. Essential components of fiber optic communication, laser-based imaging, and optical data storage—optical parametric oscillators, frequency doublers, and electro-optic modulators—consist of these crystals. One further reason L-AlaHBr is useful in optics is because it is transparent throughout a broad spectrum.

2. Piezoelectric Applications in Sensors and Transducers

The ability of L-AlaHBr crystals to produce an electric charge in response to mechanical stress is known as piezoelectricity. This characteristic is used extensively in sensor technology, especially in the creation of ultrasonic transducers for non-destructive testing, industrial monitoring, medical imaging, and similar applications. Ultrasound equipment with these crystals incorporated allow for very accurate imaging and tissue analysis in medical diagnostics. Pressure sensors, vibration detectors, and acoustic wave devices all make use of them, which helps them progress in aircraft, automobiles, and environmental monitoring.

3. Electro-Optic and Communication Systems

The potential uses of L-Alanine Hydrogen Bromide crystals in optical modulation and switching are being investigated because of their electro-optic characteristics. You may alter the intensity, phase, and polarization of light in fiber-optic communication systems using electro-optic modulators, which employ them. Optical computing, laser pulse shaping, and high-speed data transfer all rely on these modulators. An appealing material for next-generation photonic integrated circuits and communications networks, L-AlaHBr effectively manipulates light signals.

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4. Biomedical and Pharmaceutical Applications

The biomedical and pharmaceutical industries may find use for L-Alanine-based crystals, such as L-AlaHBr, because of their biocompatibility. Because of their non-toxicity and durability, they are ideal for use as biosensors, which enable them to detect enzymes, metabolites, and biomolecules with great sensitivity and specificity. They are also being considered for use in controlled drug delivery systems, which transport medicinal substances and allow for their focused distribution and accurate release. Because they are biocompatible with human cells, these crystals may also be used in regenerative medicine and tissue engineering.

5. Energy Storage and Dielectric Applications

Crystals of L-Alanine Hydrogen Bromide are well-suited for use as capacitors and energy storage devices due to their good dielectric characteristics. Microelectronics, semiconductor devices, and supercapacitors may benefit from their use since their dielectric constant values remain consistent throughout a wide range of frequencies and temperatures. They have the potential to enhance the functionality of charge storage systems and capacitors, thus researchers are looking into their use in energy-efficient electronic circuits. The increasing need for sustainable energy solutions is in line with the development of biocompatible and environmentally friendly energy materials that use these organic crystals.

6. Applications in Optical Data Storage and Quantum Computing

Researchers are looking at L-AlaHBr crystals as a potential component of high-density optical data storage devices, thanks to developments in optical technology. Their optical characteristics allow for data to be recorded and retrieved over several wavelengths, which is an improvement over conventional electrical and magnetic storage systems. Their quantum coherence and light-interacting properties also make them promising candidates for use in quantum computing, where they might aid in the creation of new quantum information processing systems.

7. Role in Photothermal and Photocatalytic Applications

Photothermal applications, in which L-Alanine Hydrogen Bromide crystals aid in the conversion of light energy into heat for medical treatments such hyperthermia therapy for cancer, have been suggested in recent research. They may also be able to assist energy-efficient catalytic processes when exposed to light, which is why their photocatalytic characteristics are being studied for potential use in water purification and pollutant degradation, among other environmental applications.

Growth Techniques for L-Alanine Hydrogen Bromide Crystals

The production of L-Alanine Hydrogen Bromide is carried out using tried-and-true methods, guaranteeing the creation of pure single crystals that may be used in a wide range of scientific and commercial contexts. Improvements in optics, electronics, and medicines have resulted from researchers' exploration of various growth processes that improve crystal size, purity, and defect-free

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morphology. The three most popular approaches are hydrothermal growth, solution growth by temperature lowering, and gradual evaporation. The required crystal characteristics and application requirements determine the choice of procedure, since each has its own set of benefits.

Slow Evaporation Technique

The slow evaporation solution growth approach is among the most popular ways for developing L-Alanine Hydrogen Bromide crystals. This approach is favored since it is easy to understand, doesn't break the bank, and yields crystals of excellent quality and shape. Several essential stages are involved in the process:

1. **Preparation of the Solution**: To begin, dissolve L-alanine in an appropriate solvent (e.g., deionized water or ethanol) with hydrogen bromide at a stoichiometric ratio. Solubility, nucleation rate, and crystal quality are all affected by the solvent chosen.
2. **Homogeneous Mixing and Supersaturation**: In order to achieve consistent interaction between the reactants, the solution is constantly swirled to mix them thoroughly. Precisely controlling the solute concentration leads to supersaturation, an essential condition for effective crystallization.
3. **Slow Evaporation under Controlled Conditions**: The solution is allowed to sit undisturbed in a controlled chamber where factors like humidity, temperature, and air circulation are carefully managed. The chances of inclusions and flaws are reduced since the solvent is allowed to evaporate slowly, which favors crystal nucleation and growth.
4. **Crystal Harvesting**: L-Alanine Hydrogen Bromide crystals start to form after a few weeks and are translucent. After the crystals reach the required size and shape, they are meticulously collected, rinsed with an appropriate solvent, and then dried to eliminate any remaining contaminants.

When working with big, flawless crystals that have outstanding optical and structural qualities, this technique shines. Preventing early nucleation and uneven development, however, calls for patience and vigilant environmental monitoring.

Solution Growth by Temperature Reduction

Crystal development of L-Alanine Hydrogen Bromide using the solution growth method by controlled temperature lowering is another well-established technique. When working with high-purity crystals that have been structurally improved, this method shines. Here are the stages that make up the process:

1. **Formation of a Supersaturated Solution**: Using a solvent and a high enough temperature to dissolve the molecule, L-Alanine Hydrogen Bromide may be made into a supersaturated solution. At higher temperatures, the material becomes more soluble, enabling the dissolving of a greater amount of solute.

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2. **Gradual Cooling Process**: The temperature is lowered at a regulated pace after the solution is created. Crystallization is sluggish and uniform because the compound's solubility drops as the temperature drops.
3. **Minimization of Defects**: Consistent growth rate is guaranteed by the controlled temperature reduction strategy, in contrast to quick cooling techniques that could cause abnormal crystal formation and excessive nucleation. The resultant crystals are more appropriate for optical and electrical applications due to the minimization of defects, dislocations, and strain inside the crystal lattice.
4. **Harvesting and Post-Growth Processing**: After enough time has passed for the crystals to mature, they are delicately removed from the solution. Next, the crystals are dried and rinsed to remove any remaining solvent or unreacted contaminants.

When high-quality crystals are required for scientific or industrial purposes, this approach is often used. Nevertheless, optimal performance requires tight regulation of temperature gradients in a steady setting.

Hydrothermal Growth Method

Hydrothermal synthesis is a common technique for producing L-Alanine Hydrogen Bromide crystals that are both very pure and devoid of defects. If you need more exact morphological control, more purity, or stronger thermal stability, this method is for you. Here are the stages involved in the hydrothermal growth process:

1. **Preparation of the Nutrient Solution**: In a high-pressure autoclave, a solution of L-Alanine and hydrogen bromide is created as a precursor. Choosing a solvent—usually water—depends on how well it dissolves the reactants when heated to high temperatures.
2. **Controlled High-Pressure Environment**: A high pressure environment is created inside the autoclave by sealing it and heating it to a precise temperature. The regulated nucleation and reactant dissolution are both enhanced by this high-pressure setting.
3. **Crystal Growth at High Temperatures**: Gradually, crystals of L-Alanine Hydrogen Bromide may be formed under circumstances of regulated temperature and pressure. Highly pure, defect-free crystals with precisely defined shape may be grown by fine-tuning the growth process with respect to pressure, temperature, and solution composition.
4. **Post-Growth Processing**: The crystals are removed from the autoclave when they have grown to the specified size. To ensure they retain their structural integrity, they are cleaned, dried, and kept in the right circumstances.

Large, high-quality crystals with outstanding mechanical and thermal characteristics may be very advantageously produced using the hydrothermal process. Specialized equipment, careful regulation of response parameters, and long development times are necessary, nevertheless.

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III. REVIEW OF LITERATURE

Kumar, Satheesh et al., (2022) One crystal of L-Alanine doped with potassium iodide was generated utilizing the conventional PI-LA technique of slow evaporation solution growth. Using single crystal x-ray diffraction, we were able to deduce the crystal's lattice parameters. Through the use of UV-Visible-NIR spectroscopy, the crystal's linear optical properties were investigated. The produced PI-LA single crystal was subjected to a mechanical stability study using the Vickers microhardness test. After testing for fluorescence, the manufactured crystal was found to emit blue light. Thanks to Z-scan analysis's open and closed aperture curves, we were able to determine the third-order nonlinear refractive index and third-order absorption coefficient, respectively. It turned out that the substance had reverse saturable absorption. The second harmonic generation measurement was carried out using the Kurtz-Perry powder technique. Several investigations have pointed to PI-LA crystals as a possible component of nonlinear systems' optical frequency converter devices.

Kirubagaran, R et al., (2015) One crystal of L-alanine DL-malic acid (LADLMA) has been grown from a water solution by use of a slow-cooling technique. According to studies conducted using powder X-ray diffraction, the crystal is structured orthorhombically. A nonlinear optical conversion efficiency test was performed on the crystals that were grown using the Kurtz powder method. The third-order nonlinear refractive index and nonlinear absorption coefficient were found by use of Z-scan measurements. Because of its negative refractive index, this material may provide protection for optical sensors and night vision equipment.

Suresh, Sagadevan. (2013) Nonlinear optical single crystals of L-phenylalanine-4-nitrophenol have been synthesized by use of the slow evaporation method. The produced crystal was subjected to research using single crystal X-ray diffraction in order to confirm its membership in the P21 space group and its monoclinic crystal structure. According to optical transmission studies, the crystal has a cutoff wavelength of 320 nm and is transparent across the whole visible spectrum. The optical band gap is found to be 3.87 eV. The real and imaginary components of the dielectric constant, the refractive index, the extinction coefficient, and transparency were all determined by analyzing the transmission of the L-phenylalanine-4-nitrophenol crystal. The mechanical behavior of the produced crystals was investigated using Vicker's microhardness tester. We find the dielectric loss and dielectric constant of L-phenylalanine-4-nitrophenol throughout a temperature range of 50 Hz to 5 MHz. The photoconductivity test proved that the substance in question does not exhibit photoconduction properties.

Kumar, P. (2011) A high-quality single crystal of L-alanine hydrobromide (LAlHBr) was produced using the slow solvent evaporation method. The created LAlHBr crystals were validated by research using single crystal X-ray diffraction. Using UV-Vis-NIR measurements, researchers have investigated the absorbance of these manufactured crystals. According to studies, these crystals absorb almost little light in the visual range. To investigate the functional groups of LAlHBr crystals, FT-IR measurements were performed. Based on the outcomes of the photoconductivity tests, LAlHBr is not photoconductive. We performed nonlinear optical research of crystals and evaluated the powdered sample's efficiency of second harmonic production using a Nd:YAG Q-switched laser. The LAlHBr crystal has a much greater SHG efficiency than KDP.

Raja, C. Ramachandra et al., (2009) The electro optical and nonlinear properties of amino acid based crystals are unparalleled. The nonlinear optical single crystal l-alaninium fumarate (LAF), a new member of the amino acid group, was created using the slow evaporation solution growth method. The results of a single crystal X-ray diffraction analysis of LAF showed that its crystal structure is orthorhombic. Excellent transparency was shown by LAF's UV-Vis-NIR spectra between 300 and 1100 nanometers. As a result, Fourier transform infrared can verify whether or not the produced crystal contains various functional groups. Results from thermogravimetric analysis (TGA) and differential thermal analysis (DTA) performed on the LAF crystal to determine its thermal characteristics indicate that the material did not decompose before melting. According to the melting point instrument, the produced crystal has a melting point of 267.5°C. Using the Nd:YAG laser's 1064 nm fundamental wavelength in a second harmonic generation test, the existence of LAF's nonlinear optical (NLO) characteristic was confirmed.

Singh, Neelam et al., (2008) A new nonlinear optical material called thiourea L-alanine acetate has been developed. One successful method for producing TLAA single crystals is the slow evaporation method. The obtained crystals have undergone a battery of tests, including dielectric measurements, X-ray diffraction (XRD), Fourier transform infrared (FTIR), second harmonic generation (SHG), research into the ultraviolet-visible spectrum, and many more. The cell is found to be part of the orthorhombic crystallographic system, space group P212121, according to the structural analysis, with cell parameters a = 6.031A˚, b = 12.32A˚, c = 5.78A˚, alpha=beta=gamma= 90 degree, and a cell volume V = 429.47A˚. 3. We were able to identify the crystals' various functional groups and their vibrational frequencies by analyzing their FTIR spectra. The optical transparency of the produced crystals was investigated by means of a UV-Vis-NIR spectrum. The energy band gap and decreased optical cutoff wavelength for this crystal are 3.74 eV and 300 nm, respectively. Thermal stability studies using thermogravimetric (TG) and differential scanning calorimetric (DSC) instruments show that TLAA is stable up to 206.22 1C. By measuring capacitance and dielectric loss over the 100 Hz-2 MHz frequency range at room temperature, the dielectric constant was ascertained. With a value of 190.92 at 100 Hz and 54.69 at 2 MHz, the dielectric constant is reduced. Narayanasamy, Vijayan et al., (2006) The electrooptical and nonlinear optical properties of amino acid crystals are rather outstanding. A single crystal of the amino acid l-Alanine has grown at room temperature using the method of slow evaporation solution development. Many methods were used to examine the created crystals, including high-resolution X-ray diffractometry (HRXRD), nuclear magnetic resonance (NMR), Fourier transform infrared spectroscopy (FTIR), ultraviolet-visible (UV-Vis), Raman spectroscopy, mass spectra analysis, and density studies. The nonlinear optical response was studied using a Q-switched Nd:YAG laser, and it was discovered that its laser damage threshold was greater than that of potassium dihydrogen phosphate (KDP).

MATERIALS AND METHODS

Single crystals of L-Alanine hydrogen bromide (LAlHBr) were created by dissolving hydrobromic acid and L-Alanine (AR grade) in double deionized water. In a solution of double-distilled water, L-alanine and hydrobromic acids are dissolved in an equimolar ratio of 1:1. The solution that is

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supersaturated has been produced. To produce crystals, the resultant watery mixture was filtered and left to evaporate at room temperature (30°C) under ideal circumstances for the slow evaporation process.

After a week of creating the solution, the seeds were meticulously gathered and filtered, and crystals formed. The goal of the recrystallization procedure is to produce large crystals. Over the course of 50 days, single crystals were produced at room temperature using a slow evaporation approach. It has been discovered that the crystals are both clear and defect-free. The picture of the grown L-Alanine hydrogen bromide crystal may be shown in Figure 1.

Figure 1: LAlHBr Crystal

IV. RESULTS AND DISCUSSION

UV-Vis-NIR Spectroscopy

These polished crystal samples, which range in thickness from 4 to 6 mm, were subjected to an optical absorption measurement for LA/HBr in the 200 nm to 2000 nm wavelength range using a Varian carry 5E model dual beam spectrophotometer.

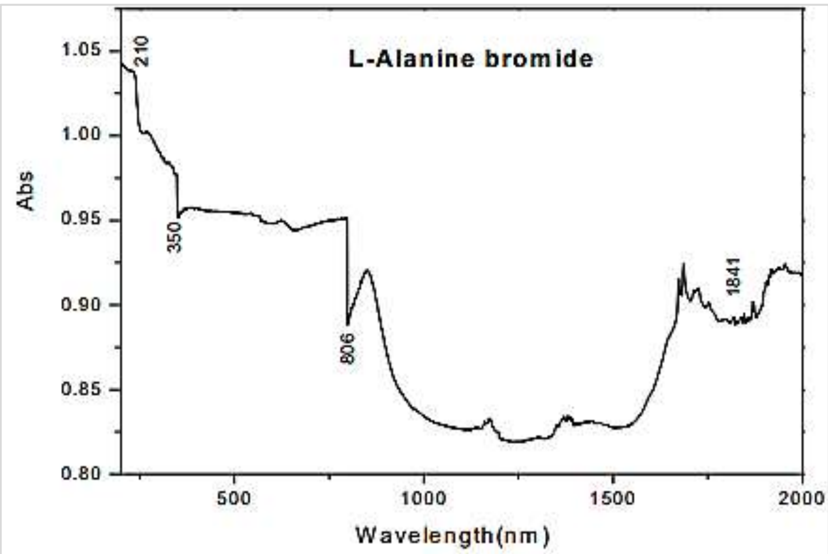

Figure 2: Optical Absorption Spectrum of LAlHBr Crystal

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As shown in Figure 2, the UV-Vis-NIR spectra of LAlHBr are shown. Across the board, the visible spectrum shows that LAlHBr crystal has very little absorption. An improved cutoff wave length beginning at 210 nm in the LAlHBr crystal makes it a good choice for NLO applications. Minimal absorption and a low cut-off wavelength are necessary for NLO action. The important wavelengths for photonic devices are those in which these crystals exhibit excellent transparency.

FT-IR Analysis

Bruker model IFS 66V spectrometer was used to record the Fourier transform infrared spectra (FTIR) of a single crystal of L-Alanine Hydrogen Bromide in the 400-4000 cm-1 frequency range. Here is the crystal's FTIR spectrum, as seen in Figure 3.

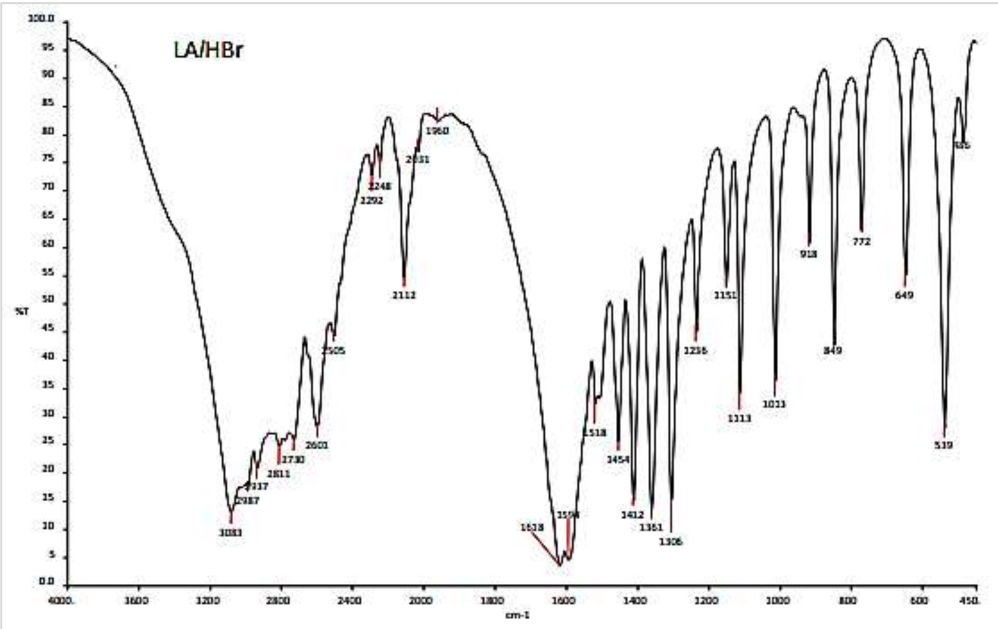

Figure 3: FTIR Spectrum of The LAlHBr Crystal

The asymmetric NH3+ stretching peak is at 3083 cm-1, whereas the -CH stretching peak is at 2937 cm-1. Hydrogen stretching is correlated with the 2601 cm-1 frequency. The absorptions at 2292–2031.1 cm-1 are a result of vibrational stretching of CH3. At 1618 cm-1, a peak corresponding to NH2-scissoring was seen. The deformation of CH3 is shown by a peak at 1454 cm-1. The bands at 1361 cm-1, which correspond to COO- stretching vibrations, may be used to determine the presence of a carboxyl group.

Photoconductivity Studies

At room temperature, photoconductivity experiments were performed on the LAlHBr crystals using a keithley 485 picoampmeter. A picoammeter and a DC power source were used to measure the samples' dark conductivity. The samples were subjected to light from a 100 W halogen lamp that contained iodine vapour, and the photo currents of each sample were recorded [4]. To test the photocurrents in the LAlHBr samples, the DC inputs were gradually raised.

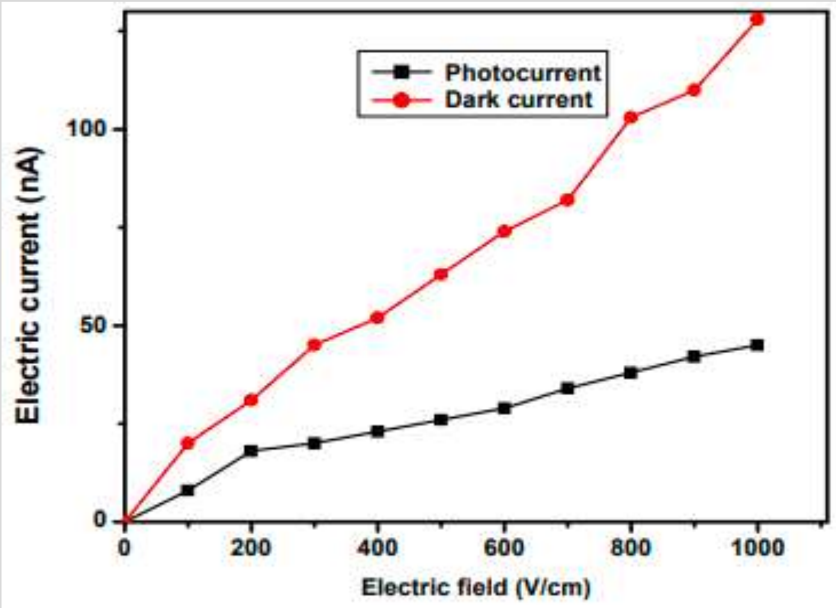

Figure 4: Photo Conductivity of LAlHBr Crystal

Photocurrent and dark current plotted against applied field for LAlHBr is shown in Figure 4. It may be inferred from the figure that LAlHBr exhibits negative photoconductivity, as the sample's dark current (Id) and photo current (Ip) both rise linearly with the applied field, and the dark current is consistently greater than the photo current.

V. CONCLUSION

Transparent and defect-free L-Alanine hydrogen bromide (LAlHBr) single crystals were produced utilizing the slow evaporation technique. Nonlinear optical (NLO) applications were proven by the optical investigation by UV-Vis-NIR spectroscopy, which verified the crystal's low cut-off wavelength of 210 nm and little absorption in the visible area. Functional group presence was confirmed by FTIR analysis, which also confirmed the crystal's molecular structure. Studies on photoconductivity showed that it was negative, meaning that the dark current was always higher than the photocurrent. These results demonstrate that LAlHBr crystals are suitable for use in high-tech optical and electrical devices, and they also emphasize their potential for photonic and optoelectronic applications.

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