Introduction
This is a presentation about the growth and characterization of L-Alanine doped triglycine sulfate (DLATGS). DLATGS is a ferroelectric material primarily used in applications of infrared detectors and imaging systems. Triglycine Sulfate (TGS) is the basis of the ferroelectric property; these crystals have the ability to spontaneously polarize under the application of an external electric field. This phenomena takes place under the Curie temperature of 49°C [1]. In order to improve the performance of IR detectors at room temperature, the Curie temperature can be raised by deuterating the crystal to form (DTGS). DTGS has a Curie temperature of 57°C [2], this material however still needs an applied external electric field to polarize.

By doping the DTGS with the amino acid L-Alanine, the crystal properties are improved by contributing to effective internal bias which inhibits ferroelectric switching giving a permanently poled single domain crystal [2]. DLATGS retains its ferroelectric property, these crystals have the ability to spontaneously polarize under the application of an external electric field to polarize.

Synthesis
The crystals were grown using high grade glycine (CH₂N₂H₂COOH) and concentrated sulfuric acid (H₂SO₄). A glycine to sulfuric acid molar ratio of 3:1 was used from the chemical equation:

\[ 3\text{(CH₂N₂H₂COOH)} + \text{H₂SO₄} \rightarrow \text{(CH₂N₂H₂COOH)₃H₂SO₄} \]

From Fig.1 the solubility of pure at 35°C is 41.85g/100mL [2]. From this we calculated that 1 liter of water will yield≈ 420g of TGS. From this the calculated values for 1 liter of water 295g of glycine and 128.4g (68mL) of sulfuric acid was needed. Scaling down to a 400mL of deionized water, the amount of glycine added was 100g and 27.2 mL of sulfuric acid. The sulfuric acid was slowly added to the DI water followed by the glycine.

Characterization
The crystals were both ground into a fine powder and analyzed using a powder X-Ray diffraction machine. The resulting data was collected for TGS (Fig.5) and DLATGS (Fig.6).

The data was compared to a peak fit model using the known unit cells of TGS and DLATGS shown in Fig.7. The comparison yielded very similar peak trends, not however exact. The next characterization test will be on a single crystal X-Ray diffraction machine, to yield a unit cell.

Conclusion
This purpose of this project was to synthesize pure triglycine sulfate and deuterated L-Alanine doped tri-glycine sulfate. Overall the experiment was executed successfully and yielded single crystals of TGS and DLATGS. The result of the single crystal XRD analysis will prove the accuracy of the unit cell.

Future Works
This project will continue will different doping materials and growth apparatus’s, also optoelectronics properties and figures of merit will be measured to test the pyroelectric performance. A temperature controlled continuous stirred batch reactor will be used to grow a single bulk DLATGS crystal in the near future.

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References

Growth and Characterization of Deuterated L-Alanine Doped Triglycine Sulfate (DLATGS)

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