

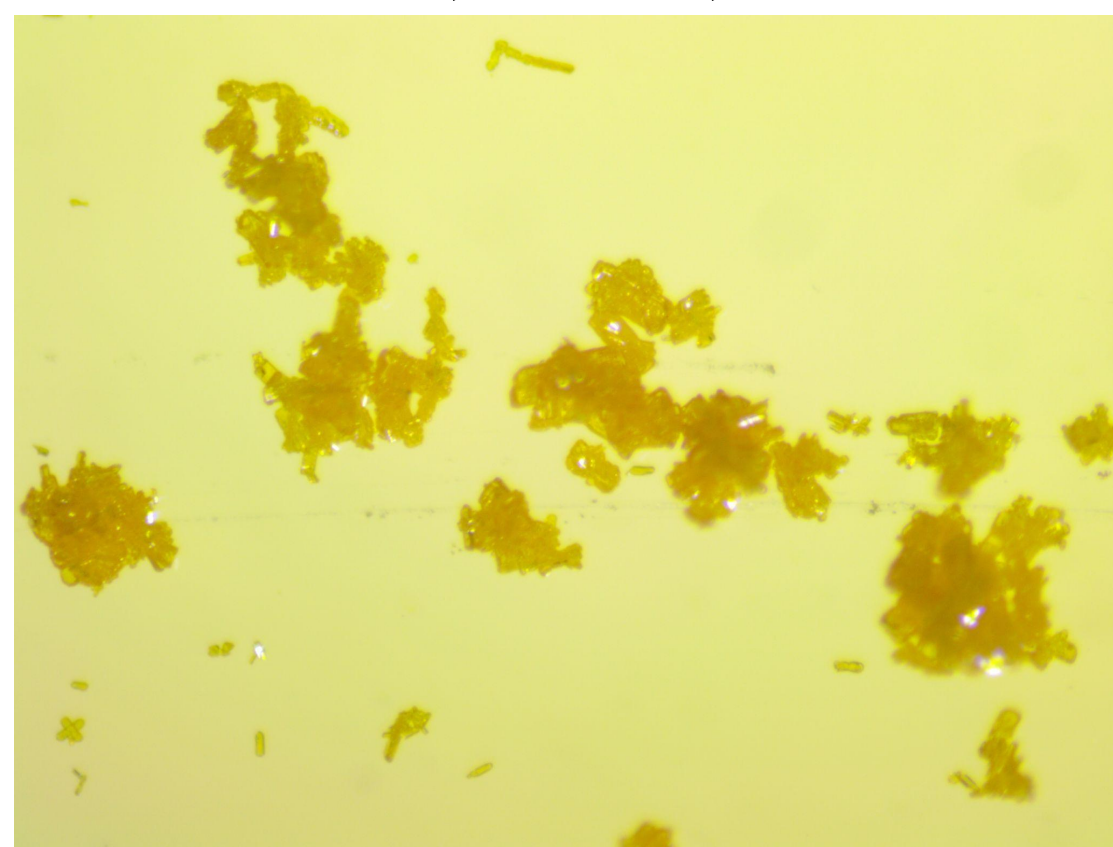
Synthesis and Characterization of Novel Cerium Crystals

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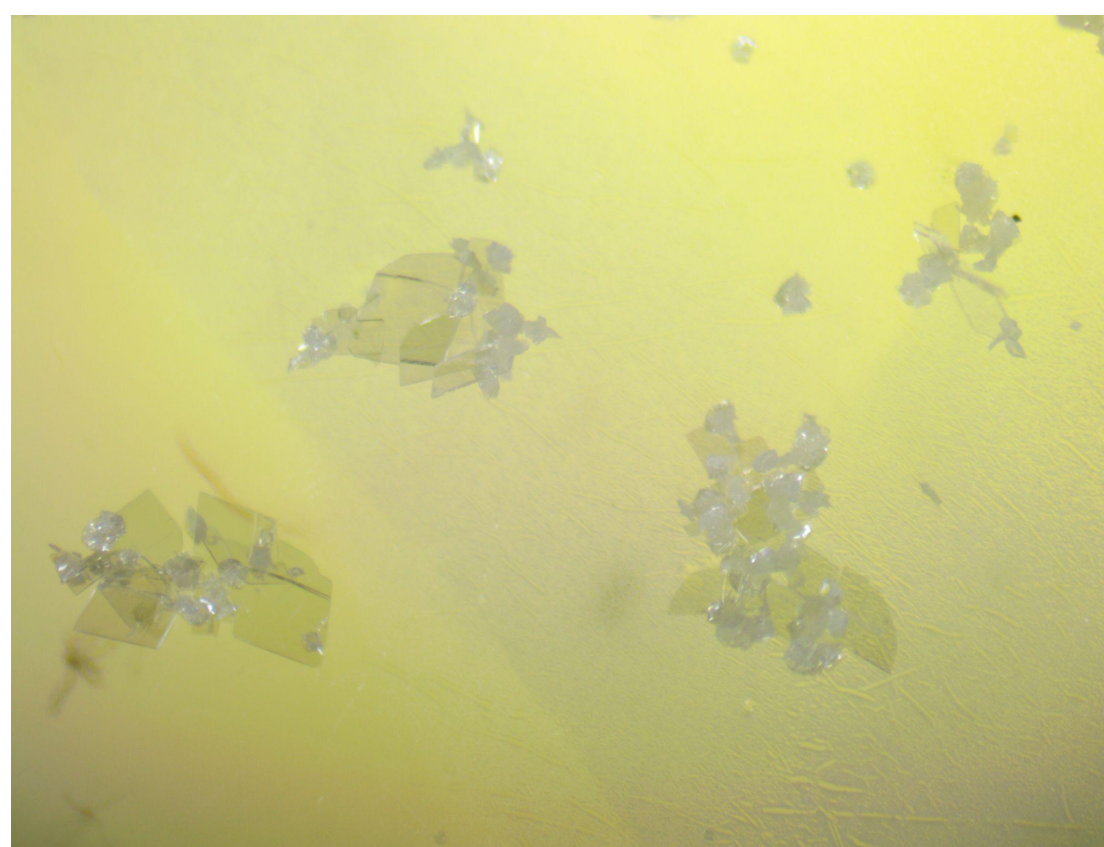
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Overview/Introduction

The purpose of this project was to synthesize novel cerium (IV) sulfate tetrahydrate and cerium (III) chloride compounds through incorporating other anions and metals, including IO₃⁻ and Fe³⁺. The incorporation of these ions are expected to introduce new optical and magnetic properties. After synthesis, Their compositions, structures, and thermal properties were analyzed using powder XRD, FTIR, and TGA.



A.



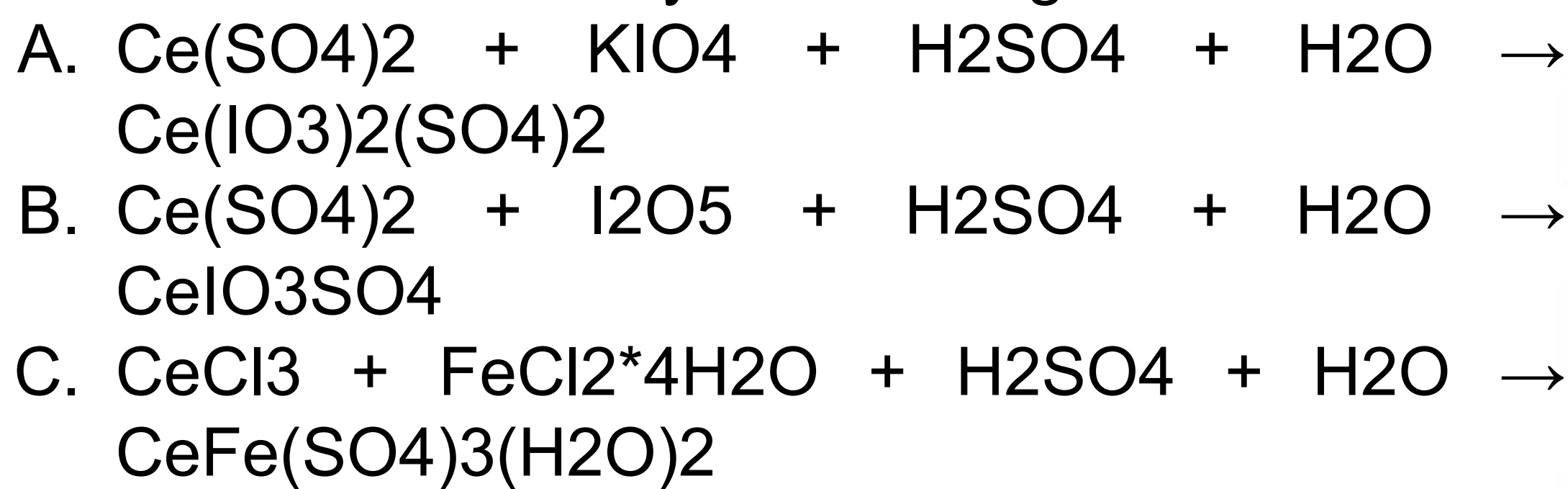
B.



C.

Key Findings/Results

Three new cerium compounds were successfully synthesized under hydrothermal conditions over the course of four days at 230 degrees Celsius.

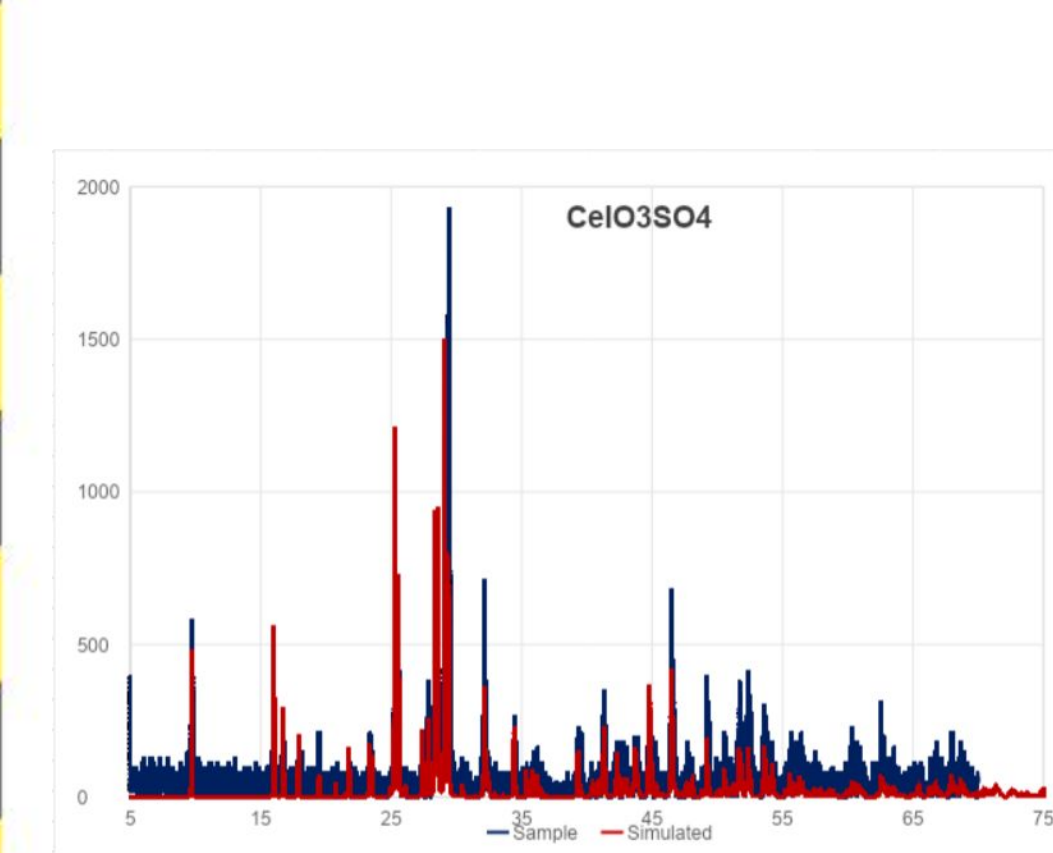


Impact/Conclusions

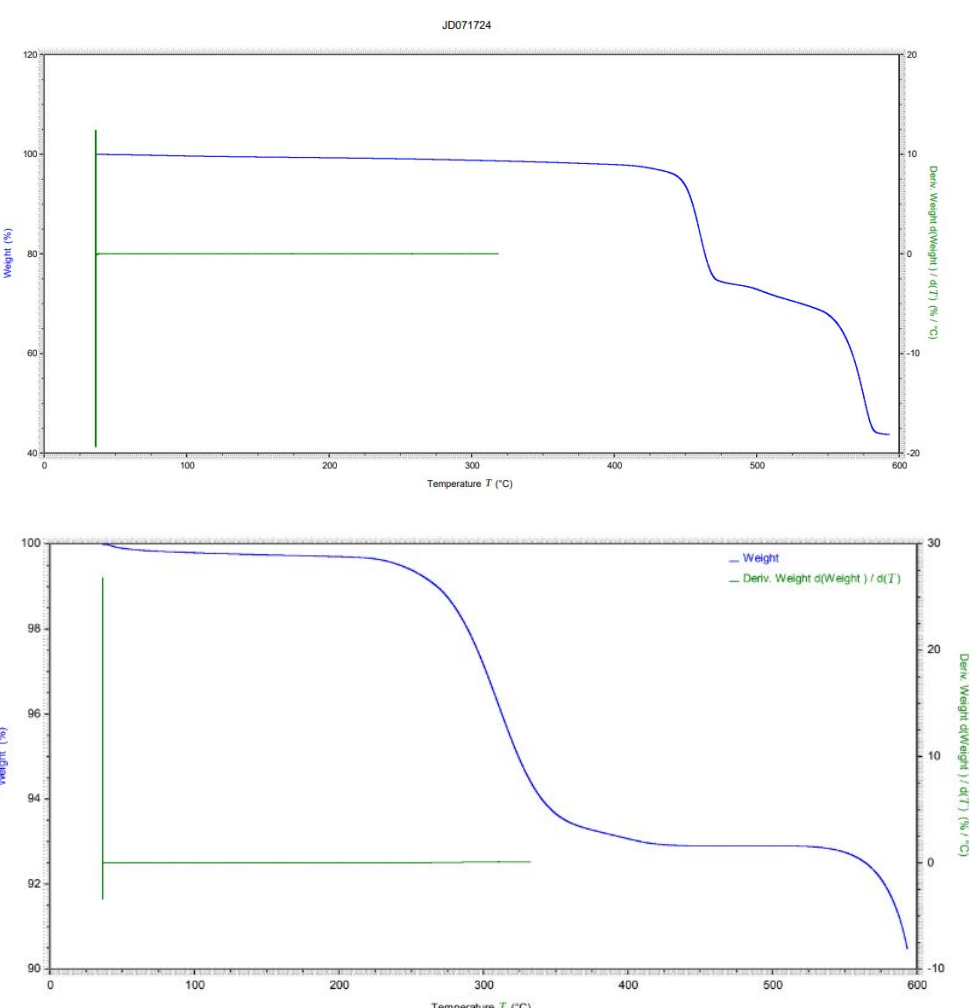
After analysis with the powder XRD, it was confirmed that all three crystal samples were pure. Further analysis with the FTIR indicated that on average, the crystal structures peaked in ranges of 600-800 cm⁻¹ and 1000-1200 cm⁻¹. This can be assigned to the vibrations of I-O and S-O bonds. Additionally, in compound C, there were peaks around 3000 cm⁻¹ and 1650 cm⁻¹, which prove the presence of water molecules. The TGA analysis also found that the compounds were generally thermally stable.

Explanation/Conceptual Framework

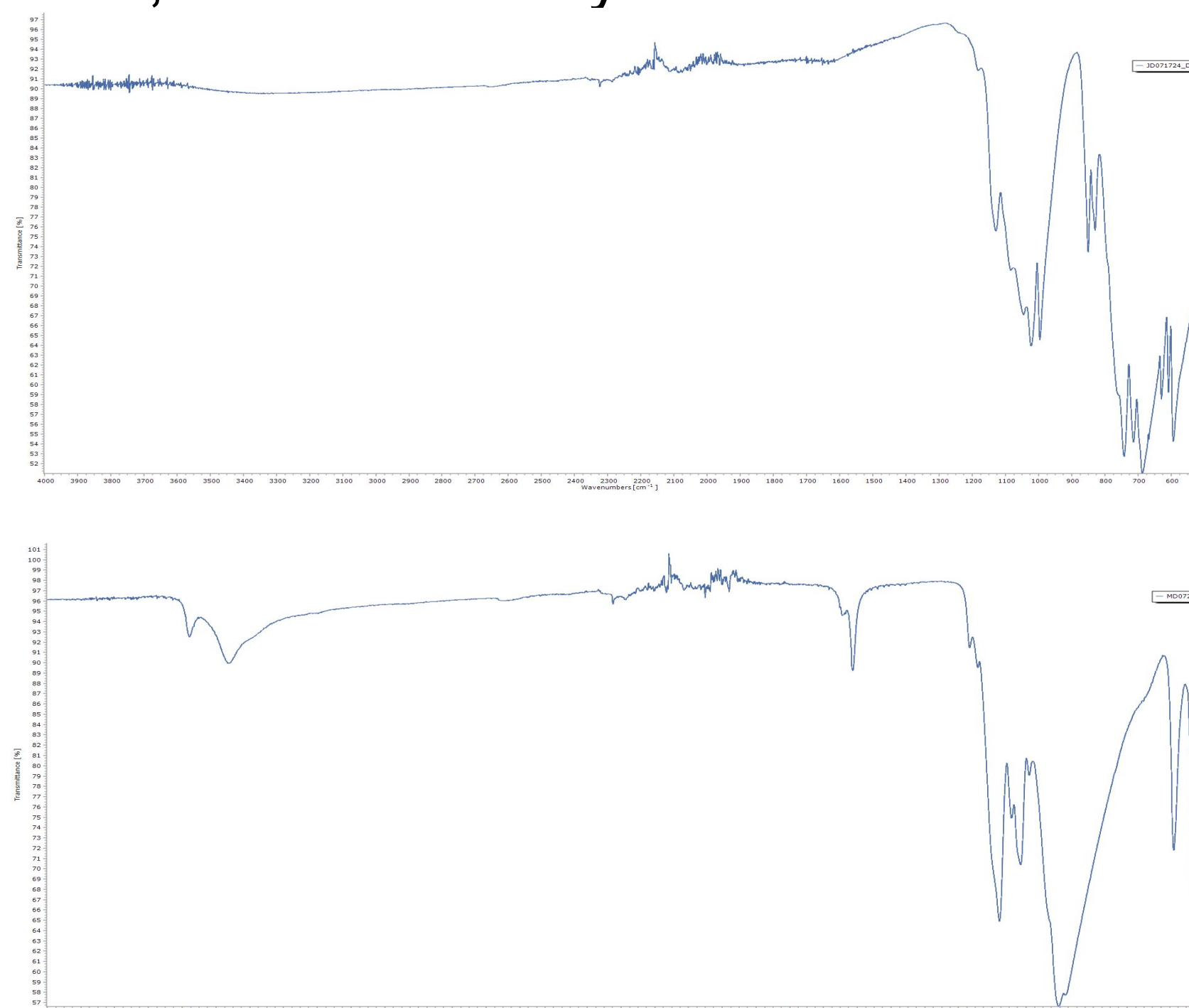
Such compounds are being studied due to their potential as nonlinear optical crystals, which are capable of altering the frequency of light. These crystals have applications in fields such as biodiagnostics, telecommunications, and quantum computing. We hope to use this project to expand our knowledge of nonlinear optical materials from the synthesis of cerium crystals. We also hope to better understand the correlation between crystal structure and optical properties through powder XRD, FTIR, and TGA analysis.



Powder XRD Data (B)



TGA Data (A and C)



FTIR Data (A and C)

References

- 1.Li, Peng-Fei, et al. "A survey of stereoactive oxysalts for linear and nonlinear optical applications." *Materials Today Physics*, vol. 37, 2023, p. 101197, <https://doi.org/10.1016/j.mtphys.2023.101197>
- 2.Dahle, Jessica, Arai, Yuji. "Environmental Geochemistry of Cerium: Applications and Toxicology of Cerium Oxide Nanoparticles." National Library of Medicine, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4344665/>

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