SLATT UNDERGRADUATE RESEARCH FELLOWSHIP
FINAL REPORT

SCHOLAR NAME:	ND Energy
FACULTY ADVISOR:	Peter Burns & Ginger Sigmon
PROJECT PERIOD:	10 weeks
PROJECT TITLE:	**Investigating the Degradation of Uranyl Peroxide Clusters under Ionizing Radiation & New Perspectives of Uranyl Peroxide Synthesis in Ionic Liquids**
CONNECTION TO ONE OR MORE ENERGY-RELATED RESEARCH AREAS (CHECK ALL THAT APPLY):	**( ) Energy Conversion and Efficiency (x) Sustainable and Secure Nuclear** **( ) Smart Storage and Distribution ( ) Transformation Solar** **( ) Sustainable Bio/Fossil Fuels ( ) Transformative Wind**

MAJOR GOALS AND ACCOMPLISHMENTS

Summarize your research goals and provide a brief statement of your accomplishments (no more than 1-2 sentences). Indicate whether you were able to accomplish your goals by estimating the percentage completed for each one. Use the next page for your written report.

RESEARCH GOALS	ACTUAL PERFORMANCE AND ACCOMPLISHMENTS	% OF GOAL COMPLETED
Know more about nuclear energy.	My project been about nuclear energy it helps to gain more knowledge and how this work.	100
Be involve in the chemistry field.	My mentors help me to understand all about the radioactive material and its compositions.	100
Learn safer ways to work with radiation.	They made us take an introduction and safe ways to manage radioactive materials and how to work with them.	100
Develop myself in the practice field	Teorical and practice are two different things, been able to put the practice to the lead was a very good way to learn more about materials, nuclear, meeting, lab work and develop myself in the nuclear concentration.	100
Apply my knowledge of engineering in the labs	Many times, I was aware of the things I was doing because I had studied them before, but mostly I learned new things	95

RESEARCH OUTPUT

Please provide any output that may have resulted from your research project. You may leave any and all categories blank or check with your faculty advisor if you are unsure how to respond.

CATEGORY	INFORMATION
EXTERNAL PROPOSALS SUBMITTED	N/A
EXTERNAL AWARDS RECEIVED	N/A
JOURNAL ARTICLES IN PROCESS OR PUBLISHED	N/A
BOOKS AND CHAPTERS RELATED TO YOUR RESEARCH	N/A
PUBLIC PRESENTATIONS YOU MADE ABOUT YOUR RESEARCH	(Symposium, Investigating the Degradation of Uranyl Peroxide Clusters under Ionizing Radiation & New Perspectives of Uranyl Peroxide Synthesis in Ionic Liquids, July 20 2022, Jordan Hall Building)
AWARDS OR RECOGNITIONS YOU RECEIVED FOR YOUR RESEARCH PROJECT	N/A
INTERNAL COLLABORATIONS FOSTERED	N/A
EXTERNAL COLLABORATIONS FOSTERED	N/A
WEBSITE(S) FEATURING RESEARCH PROJECT	(URL)

OTHER PRODUCTS AND SERVICES (e.g., media reports, databases, software, models, curricula, instruments, education programs, outreach for ND Energy and other groups)	N/A

RESEARCH EXPERIENCE

Please let us know what you thought of your research experience: Did this experience meet your expectations? Were lab personnel helpful and responsive to your needs? What else could have been done to improve your experience or achieve additional results?

My experience in this research was of great help to my work performance. It helped me understand the labor field and how to improve in some ways. Every day in the laboratory I learned new things about the topics I was studying and how to put them into practice in the future. My mentors were of great help both to teach me and to have fun, this caused me to want to learn more about the research topics. This research was also very helpful in making a graduate school decision and what I want to do.

Investigating the Degradation of Uranyl Peroxide Clusters under Ionizing Radiation & New Perspectives of Uranyl Peroxide Synthesis in Ionic Liquids

Gabriela Roman Perez[1], Zoe Emory[2], Cale Gaster[2], and Peter C. Burns[2,3]

[1] University of Puerto Rico, Mayaguez
[2] University of Notre Dame, Department of Chemistry and Biochemistry
[3] University of Notre Dame, Department of Civil and Environmental Engineering and Earth Sciences

Abstract:

Actinide chemistry is an important field with regard to energy sciences. This summer I worked on two projects that could have potential implications in the nuclear fuel cycle: studying the degradation of uranyl peroxide cage clusters (UPCs) in high radiation fields and the synthesis of UPCs using ionic liquids. UPCs easily form in alkaline aqueous conditions, increasing the likelihood of their presence in nuclear waste environments. Using the effects of α radiation, simulated with He^{2+} ions using the 9s accelerator in the Nuclear Physics Lab at the University of Notre Dame, we investigated how the Li-U_{24} ($Li_{24}[(UO_2)_{24}(O_2)_{24}(OH)_{24}]$) structure changes when exposed to high radiation doses. Using Raman and infrared spectroscopy as our main spectroscopic methods, Li-U_{24} shows changes in its bonding environments as the peaks change with increasing radiation dose. The second project consists of synthesizing new UPCs using ionic liquids as a solvent or co-solvent. Studtite is a uranyl peroxide mineral used in the nuclear fuel cycle, and dissolves in ionic liquids. UPCs are typically formed via the reaction between studtite, hydrogen peroxide, and an alkali hydroxide base, thus producing UPCs with an alkali counter cation. When dissolved in the ionic liquid, studtite is able to react and form UPCs with counter cations not typically involved in traditional UPC syntheses (e.g. lanthanides). New species will be characterized via single crystal X-ray diffraction, Raman spectroscopy, small angle X-ray scattering, and electrospray ionization mass spectrometry.