

SLATT UNDERGRADUATE RESEARCH FELLOWSHIP FINAL REPORT

SCHOLAR NAME:	Jeff Matu Mwathi
FACULTY ADVISOR:	Dr. Ian Lightcap
PROJECT PERIOD:	Summer 2022
PROJECT TITLE:	Testing Sub-2 nm Fe Nanoparticles on Graphene for the Oxygen Reduction Reaction
CONNECTION TO ONE OR MORE ENERGY-RELATED RESEARCH AREAS (CHECK ALL THAT APPLY):	<input type="checkbox"/> Energy Conversion and Efficiency <input type="checkbox"/> Sustainable and Secure Nuclear <input type="checkbox"/> Smart Storage and Distribution <input type="checkbox"/> Transformation Solar <input type="checkbox"/> Sustainable Bio/Fossil Fuels <input type="checkbox"/> 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
Making of graphene oxide	The graphite adequately reduced through the use of strong sulphuric acid to form graphene oxide.	100
Iron nano-particle synthesis	We successfully made thin iron films, although their desired thickness was slightly larger than intended.	80

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	(Sponsor, Project Title, PIs, Submission Date, Proposal Amount)
EXTERNAL AWARDS RECEIVED	(Sponsor, Project Title, PIs, Award Date, Award Amount)
JOURNAL ARTICLES IN PROCESS OR PUBLISHED	(Journal Name, Title, Authors, Submission Date, Publication Date, Volume #, Page #s)
BOOKS AND CHAPTERS RELATED TO YOUR RESEARCH	(Book Title, Chapter Title, Authors, Submission Date, Publication Date, Volume #, Page #s)
PUBLIC PRESENTATIONS YOU MADE ABOUT YOUR RESEARCH	(Event, Presentation Title, Presentation Date, Location)
AWARDS OR RECOGNITIONS YOU RECEIVED FOR YOUR RESEARCH PROJECT	(Purpose, Title, Date Received)
INTERNAL COLLABORATIONS FOSTERED	(Name, Organization, Purpose of Affiliation, and Frequency of Interactions)
EXTERNAL COLLABORATIONS FOSTERED	(Name, Organization, Purpose of Affiliation, and Frequency of Interactions)
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)	(Please describe each item in detail)

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?

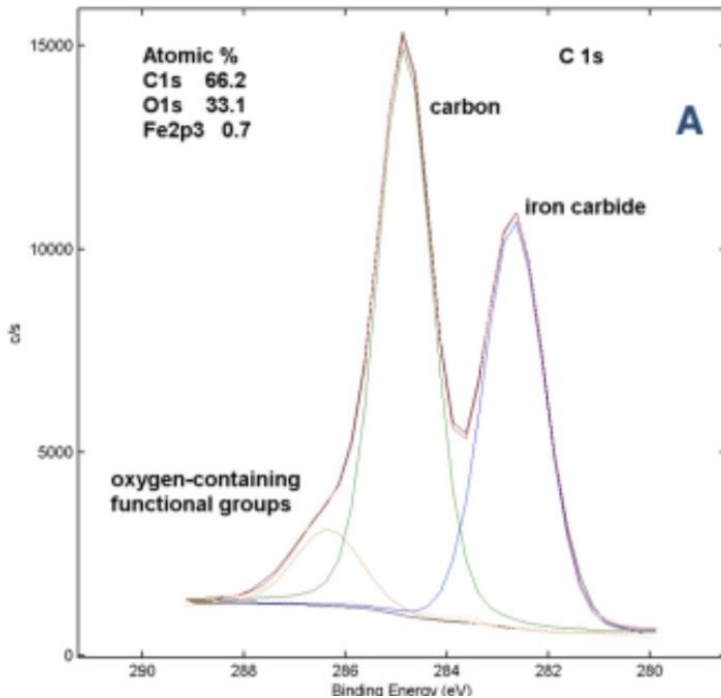
I really did feel like this research experience gave me a foundational knowledge regarding the field of sustainable energy. I was able to solidify my interest within this ever-growing field, with my eventual goal being pioneering the shift towards completely sustainable energy in my home country Kenya.

FINAL WRITTEN REPORT

(Please use the space below to describe your research project and objectives, any findings and results you can share, and graphs, charts, and other visuals to help us understand what you achieved as a result of this research experience.)

My research experience mainly involved the synthesis of iron nanoparticles on reduced graphene oxide. Ferric oxides are a viable photocatalyst due to their natural abundance, however, due to short charge carrier diffusion lengths, their efficiency is limited.

Here is a visual example of our findings using xps characterization to determine the efficiency of our Fe₂O₃ synthesis:



XPS Characterization

A: Peak at 285 eV indicates presence of carbon; Peak at ~282 eV indicates presence of iron carbide

B: Peak at ~530 eV likely indicates presence of Iron Oxide

C: Graph indicates sample contains FeO and Fe₃C

However, as discussed with both Ian and Barbara, I split my time between the Slatt project as well as the Alpha project, which I spent slightly more time on. With regards to the Alpha project, I learned multiple analysis techniques of carbon, such as Raman Spectroscopy, X-Ray crystallography, as well as Fourier-transform infrared spectroscopy.