Monty R. Cosby

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Research Vision: To characterize and develop materials for electrochemical applications in the pursuit of improved energy technologies. Research pertains to developing novel high-throughput methods, creating on-the-fly analysis tools, and utilizing mathematical modeling to optimize materials processes.

Education

Ph. D.	Stony Brook University (*2017- 2022*) Focus: Chemistry, Materials Chemistry	Department of Chemistry
B.S.	University of Oregon (*2013- 2017*) Major: Chemistry, Minor: Economics	Department of Chemistry

Held Positions

Postdoc	SLAC/Stanford University (*2022- present*) Advisor, Dr. Kevin Stone	SSRL Materials Science Division

Research

2022- *present* *Materials Chemistry* Advisor: Dr. Kevin Stone, SLAC/Stanford

Work on *operando* XRD, PDF, XAS, and GIWAX analysis of structural changes within perovskite photovoltaic materials and the formation of amorphous phases through cell decomposition. High-throughput on-the-fly analysis of photovoltaic structural evolutions combined with machine learned databases will be used for beamline automation.

2017- 2022 *Functional Materials Chemistry* Advisor: Pr. Peter Khalifah, Stony Brook

Thesis title: Quantitative analysis of chemical and electrochemical processes relevant to energy storage using rapid and sensitive synchrotron diffraction methods. Studied reaction pathways and Li metal battery systems using high throughput *in situ* and *operando* synchrotron X-ray powder diffraction methods. Material structure evolutions were determined by sequential Rietveld refinements often exceeding a thousand scans on one compound per day. To actively monitor reaction progress, an automated refinement Python code was created to integrate, refine, and analyze synchrotron data on-the-fly. Work was split into three separate projects: (1) investigating ion exchange kinetics and thermodynamics for optimizing solid electrolyte creation, (2) mathematically modeling thick cathode gradients with computational software: MAPLE, and (3) lateral mapping battery electrode inhomogeneities by synchrotron diffraction.

2015- 2017 *Electrocatalysis* Advisor: Pr. Shannon Boettcher, Oregon

Studied first-row transition metal electrocatalysts (Ni, Mn, Co) for water splitting. Blueprinted and fabricated an anion-exchange water electrolysis system for real world

testing of oxygen evolution reaction electrocatalysts. Synthesized and characterized nanomaterials for use in water electrolysis system.

Awards and Fellowships

2022 Chemistry Award for Outstanding Doctoral Student – Stony Brook University

2020- 2021 NSF NRT Fellowship (Quantitative Analysis of Dynamic Structures)
Competitive award given to PhD students that have demonstrated exemplary research in data-intensive synchrotron methods. Program includes trainings on various synchrotron techniques and career development.

Skills

- Have led >15 beamline experiments, participated in >35 total at the Advanced Photon Source, National Synchrotron Light Source II, Stanford Synchrotron Radiation Lightsource and Spallation Neutron Source.
- Solid state synthesis.
- High throughput computational data analysis.
- Coding in Python, Igor, MAPLE, and beamline specific languages: Spec and BlueSky.
- Mentored 2 undergraduate researchers who have written and presented senior research theses.
- Electrochemical techniques using MACCOR, BioLogic, and Gamry instruments.

Other Activities

2020- 2021 Seminar Coordinator: GENESIS EFRC: Early Career Team

2018- 2021 Laboratory Safety Officer, Khalifah Group, Stony Brook University

2020- 2021 Chem. Dept. Empowering Safe Practices Team, Stony Brook University

2017- 2018 Teaching Assistant, General Chemistry, Stony Brook University

2018 Modern Methods in Rietveld Refinement for Structural Analysis School

Publications

6. **Cosby, M.R.**; Carignan, G. M.; Li, Z.; Efaw, C.M.; Yin, L; Dufek, E.J.; Li, B.; Khalifah, P.G., Synchrotron high energy lateral mapping studies of inhomogeneities in pouch cell batteries. *JES.* **2022**, *169*, 020571. [doi]

5. Li, Z.; Yin, L.; Mattei, G. S; **Cosby, M. R**.; Lee, B. S.; Wu, Z.; Bak, S. M.; Chapman, K.; Yang, X. Q.; Liu, P.; Khalifah, P.G., Synchrotron *operando* depth profiling studies of state-of-charge gradients in thick $Li(Ni_{0.8}Mn_{0.1}Co_{0.1})O_2$ cathode films. *Chem. Mater.* **2020**, *32* (15), 6358-6364. [doi]

4. **Cosby, M. R**.; Mattei, G. S.; Wang, Y.; Li, Z.; Bechtold, N.; Chapman, K. W.; Khalifah, P. G., Salt effects on Li ion exchange kinetics of $Na_2Mg_2P_3O_9N$ – Systematic *in situ* synchrotron diffraction studies *J. Phys. Chem. C* **2020**, *124* (12), 6522-6527. [doi]

3. Liu, H.; Li, Z.; Grenier, A.; Kamm, G. E.; Yin, L.; Mattei, G. S.; **Cosby, M. R**.; Khalifah, P. G.; Chupas, P. J.; Chapman, K. W., Best practices for *operando* depth-resolving battery experiments. *J. App. Crystallogr.* **2020**, *53* (1), 133-139. [doi]

2. Xu, D.; Stevens, M. B.; **Cosby, M. R**.; Oener, S. Z.; Smith, A. M.; Enman, L. J.; Ayers, K. E.; Capuano, C. B.; Renner, J. N.; Danilovic, N., Earth-abundant oxygen electrocatalysts for alkaline anion-exchange-membrane water electrolysis: Effects of catalyst conductivity and comparison with performance in three-electrode cells. *ACS Cat.* **2018**, *9* (1), 7-15. [doi]

1. Stevens, M. B.; Enman, L. J.; Batchellor, A. S.; **Cosby, M. R.**; Vise, A. E.; Trang, C. D.; Boettcher, S. W., Measurement techniques for the study of thin film heterogeneous water oxidation electrocatalysts. *Chem. Mater.* **2017**, *29* (1), 120-140. [doi]

Presentations

12. Stony Brook Chemistry Research Day, October 2021, "Resolving the origin of thermodynamic and kinetic limitations in solid state ion exchange"
11. 240th Electrochemical Society Meeting, October 2021, "Mapping the deposition of Li metal in pouch cells by synchrotron diffraction" [doi]
10. 71st Annual Meeting of the American Crystallographic Association, August 2021, "Salt effects on Li-ion exchange kinetics and activation energies – systematic *in situ* synchrotron diffraction studies" [doi]
9. Stony Brook Chemistry Research Day, March 2021, "How does salt choice effect the thermodynamics of ion exchange?"
8. Battery 500 Consortium, in-person quarterly review meeting, November 2019, "Modeling potential gradients in thick NMC cathodes"
7. North American Solid State Chemistry Conference, August 2019, "*In situ* studies of ion exchange reactions of $Na_2Mg_2P_3O_9N$: kinetic and thermodynamic insights"
6. Stony Brook Chemistry Research Day, October 2019, "*In situ* studies of ion exchange reactions of $Na_2Mg_2P_3O_9N$: Kinetic and thermodynamic insights"
5. Battery 500 Consortium, in-person quarterly review meeting, April 2019, "Modeling State-of-Charge Gradients in Operating Thick Battery Cathodes"
4. Battery 500 Consortium, in-person quarterly review meeting, December 2018, "Modeling of Experimental Depth Profiling Data"
3. Stony Brook Chemistry Research Day, October 2018, "Modeling state-of-charge gradients in operating thick battery cathodes"
2. ACS Undergraduate Research Symposium PSU, September 2016, "Characterization of Nanoparticulate Oxygen Evolution Catalysts for use in an Anion Exchange Water Electrolysis System"
1. University of Oregon Energy and Sustainable Materials symposium, June 2016, "The impact of electrolyte, morphology, and structure on catalysts for the oxygen evolution reaction"