

# JOSHUA J. ZAK

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## SUMMARY

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- Electrochemist and materials characterization expert with 5+ years of experience in Li-ion battery work
- Skilled in science communication to various audiences ranging from academics and students to funding agencies and industry leaders through 20+ oral and poster presentations and peer review/editing
- Demonstrated ability to spearhead collaborative efforts in and out of an academic setting through team and project management and volunteer activities

## EDUCATION

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**California Institute of Technology – Pasadena, CA** *Sep 2017 – Expected Fall 2022*

Doctor of Philosophy, Chemistry; Cumulative GPA: 3.85/4.00; NSF Graduate Research Fellow

Advisor: Kimberly A. See

Thesis: *Complex Charge Compensation Mechanisms in Lithium-Rich Chalcogenide Cathodes*

**Carnegie Mellon University – Pittsburgh, PA** *Aug 2013 – May 2017*

Bachelor of Science, Chemistry; Cumulative GPA: 3.80/4.00; Science and Humanities Scholar

Concentration: Materials Chemistry

Minor: Japanese Studies (Language and Culture)

## RESEARCH EXPERIENCE

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**California Institute of Technology – Pasadena, CA**

*Division of Chemistry and Chemical Engineering*

*Dec 2017 – Present*

*Graduate Research Assistant, lab of Prof. Kimberly A. See*

- Determined charge compensation mechanisms in high-capacity Li-rich sulfide materials, successfully leading efforts to find definitive spectroscopic evidence of reversible anionic contributions to redox
- Controlled effects of metal-anion covalency and determined local structure response to anion oxidation in a series of Li-rich chalcogenide cathodes to uncover relationships to reversibility and performance
- Initiated development of in-house *operando* Raman spectroscopy capabilities and investigated local structural consequences of a dynamically changing redox mechanism in a mixed metal Li-rich oxide
- Contributed spectroscopic and electrochemical expertise to cross-cutting efforts within the SCALAR DOE Energy Frontiers Research Center in collaboration with groups from 5 other institutions

**Carnegie Mellon University – Pittsburgh, PA**

*Department of Chemistry, Mellon College of Science*

*May 2014 – May 2017*

*Undergraduate Research Assistant, lab of Prof. Stefan Bernhard*

- Led a project to synthesize photostable iridium metal complexes with long-lived excited states for use as catalysts for hydrogen evolution and other industrially relevant small molecule transformations
- Awarded ACS Undergraduate Award in Inorganic Chemistry for excellence in inorganic coursework and research

## TECHNIQUES AND SKILLS

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**Electrochemistry:** cyclic voltammetry, galvanostatic cycling, galvanostatic intermittent titration technique, electrochemical impedance spectroscopy

**Materials Science:** solid-state synthesis, X-ray diffraction, synchrotron X-ray experiments (X-ray absorption spectroscopy, total scattering pair distribution function, hard X-ray photoelectron spectroscopy, resonant inelastic X-ray scattering), Raman spectroscopy, scanning electron microscopy

**Computer:** Demeter suite (XANES and EXAFS analysis), GSAS-II (XRD and PDF analysis), Biologic (EC-Lab) and MACCOR electrochemical testing software, LaTeX, Mathematica, Microsoft Office

**Languages:** English (native speaker), Japanese (conversational)

## PUBLICATIONS ([Google Scholar](#)) \*indicates co-first authorship

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3. Martinolich, A. J.\*; **Zak, J. J.\***; Kim, S. S.; Bashian, N. H.; Irshad, A.; Agyeman-Budu, D.; Narayan, S.; Melot, B. C.; Nelson Weker, J.; See, K. A. Controlling Covalency and Anion Redox Potentials through Anion Substitution in Li-rich Chalcogenides. *Chem. Mater.* **2021**, *33*, 378–391.
2. Bashian, N. H.; Preefer, M. B.; Milam-Guerrero, J.; **Zak, J. J.**; Sendi, C.; Ahsan, S.; Vincent, R.; Haiges, R.; See, K. A.; Seshadri, R.; Melot, B. C. Understanding the Role of Crystallographic Shear on the Electrochemical Behavior of Niobium Oxyfluorides. *J. Mater. Chem. A.* **2020**, *8*, 12623.
1. Hansen, C. J.\*; **Zak, J. J.\***; Martinolich, A. J.; Ko, J. S.; Bashian, N. H.; Kaboudvand, F.; Van der Ven, A.; Melot, B. C.; Nelson Weker, J.; See, K. A. Multielectron, Cation and Anion Redox in Lithium-Rich Iron Sulfide Cathodes. *J. Am. Chem. Soc.* **2020**, *142*, 6737–6749.

## MANUSCRIPTS IN SUBMISSION/REVIEW

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4. **Zak, J. J.**; Zuba, M.; Lebens-Higgins, Z. W.; Huang, H.; Crafton, M. J.; McCloskey, B. D.; Piper, L. F. J., See, K. A. Irreversible Anion Redox and Dynamically Changing Charge Compensation in Low-Ru Li-rich Cathode  $\text{Li}_2\text{Ru}_{0.3}\text{Mn}_{0.7}\text{O}_3$ . *In preparation*.
3. **Zak, J. J.**; Kim, S. S.; Laskowski, F. A. L.; See, K. A. From Intercalation to Conversion and the Hybrid Mechanisms Between: An Exploration of Sulfur Redox in Li Cathodes. *In preparation*.
2. Kim, S. S.; Agyeman-Budu, D. N.; **Zak, J. J.**; Dawson, A.; Yan, Q.; Caban-Acevedo, M.; Yao, Y.; Irshad, A.; Narayan, S. H.; Luo, J.; Nelson Weker, J.; Tolbert, S. H.; See, K. A. Promoting Reversibility of Multielectron Redox in Alkali-Rich Sulfide Cathodes through Cryomilling. *In review, Jan 2022*.
1. Wyckoff, K. E.; Kaufman, J. L.; Baek, S. W.; Dolle, C.; **Zak, J. J.**; Bienz, J.; Kautzch, L.; Vincent, R. C.; Zohar, A.; See, K. A.; Eggeler, Y. M.; Pilon, L.; Van der Ven, A.; Seshadri, R. Metal-Metal Bonding as an Electrode Design Principle in the Low-Strain Cluster Compound  $\text{LiScMo}_3\text{O}_8$ . *In review, Nov 2021*.

## SELECTED PRESENTATIONS

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**Oral**, Materials Research Society, “Controlling Covalency and Anion Redox Potentials through Anion Substitution in Li-rich Chalcogenides.” 2021

**Oral (invited)**, Stanford Synchrotron Radiation Lightsource Monthly Seminar, “Tunable Multielectron Redox in Lithium-Rich Iron Chalcogenide Cathodes.” 2020

**Oral**, Energy Frontiers Research Center Principal Investigator Meeting, “Investigating the Redox Activity and Lithiation of Boron Icosahedra in the Solid State.” 2019

## HONORS & AWARDS

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**Fellow**, National Science Foundation Graduate Research Fellowship Program, 2019-present

**Poster Award**, Caltech Division of Chemistry and Chemical Engineering Seminar Day, 2019

**Team Science Award**, Office of Basic Energy Sciences, U.S. Department of Energy, 2018

**Student Service Award**, Carnegie Mellon Alumni Association, 2017 (highest university award for service)

**Scholar**, Andrew Carnegie Society, 2017 (given to 40 graduating seniors in a class of 1600)

## SELECTED COMMUNITY INVOLVEMENT

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**Student Representative**, Chemistry Graduate Studies Committee, Caltech, 2019-present

- Planned division-wide activities and townhalls, and advocated for policy changes with regards to diversity, equity, inclusion, and accessibility in graduate student recruitment and retention

**Student Leader**, PRISM/oSTEM, Caltech, 2018-present

- LGBTQ+ and allies group focused on organizing social and educational programs for the Caltech community and outreach opportunities in the greater Los Angeles area

**Student Representative**, LGBTQ+ Working Group, Caltech, 2018-present

- Worked with LGBTQ+ faculty and staff to advocate for a safe and vibrant environment for queer students