

# David T. Boyle

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## Academic Background

### Stanford University

2017 - Present

- Ph.D. Candidate in Chemistry  
Advisor – Prof. Yi Cui  
*Electrochemical Approaches to Illuminate the Effect of Electrolyte Composition on Kinetic Processes within Lithium Batteries*

### James Madison University

2013 - 2017

- Bachelor of Science in Chemistry – ACS Certified Materials Chemistry, *Magna Cum Laude*
  - o Minor in Materials ScienceAdvisor – Prof. Ashleigh E. Baber  
*Honors Thesis—Elucidation of Active Sites for the Reaction of Ethanol on TiO<sub>2</sub>/Au(111)*

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## Awards/Research Funding

### NSF – GREP Fellow

2018-2023

National Science Foundation – Graduate Research Fellowship

### ACS Award in Physical Chemistry

2017

James Madison University Department of Chemistry and Biochemistry

### Degesch America Award

2017

James Madison University Department of Chemistry and Biochemistry

### Polocsay Award in Undergraduate Research

2016

James Madison University Department of Chemistry and Biochemistry

### C-CLEAR Research Experience for Undergraduates (REU)

2016

Colorado State University Department of Chemistry

### Research Experience for Undergraduates (REU) Scholarship

2015

James Madison University College of Math and Science

### Second Century Scholarship for Science, Technology, Engineering, and Mathematics (STEM)

2013-2017

James Madison University

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## Publications

9. **Boyle, D. T.**; Kong, X.; Pei, A.; Rudnicki, P. E.; Shi, F.; Huang, W.; Bao, Z.; Qin, J.; Cui, Y. Transient Voltammetry Reveals the Electron Transfer Kinetics of Lithium Metal Anodes. *ACS Energy Lett.* **2020**, Articles ASAP.  
DOI: [10.1021/acsenergylett.0c00031](https://doi.org/10.1021/acsenergylett.0c00031)
8. Huang, W.; Wang, J.; Braun, M. R.; Zhang, Z.; Li, Y.; **Boyle, D. T.**; McIntyre, P. C.; Cui, Y. Dynamic Structure and Chemistry of the Silicon Solid-Electrolyte Interphase Visualized by Cryogenic Electron Microscopy. *Matter* **2019**, *1*, 1232-1245.  
DOI: [10.1016/j.matt.2019.09.020](https://doi.org/10.1016/j.matt.2019.09.020)

7. Huang, W.\*; Attia, P. M.\*; Wang, H.; Renfrew, S. E.; Jin, N.; Das, S.; Zhang, Z.; **Boyle, D. T.**; Li, Y.; Bazant, M. Z.; McCloskey, B. D.; Cheuh, W. C.; Cui, Y. Evolution of the Solid–Electrolyte Interphase on Carbonaceous Anodes Visualized by Atomic-Resolution Cryogenic Electron Microscopy. *Nano Lett.* **2019**, *19*, 5140-5148.  
DOI: [10.1021/acs.nanolett.9b01515](https://doi.org/10.1021/acs.nanolett.9b01515)
6. Chen, H.; Pei, A.; Lin, D.; Xie, J.; Yang, A.; Xu, J.; Lin, K.; Wang, J.; Wang; H.; Shi, F.; **Boyle, D. T.**; Cui, Y. Uniform High Ionic Conducting Lithium Sulfide Protection Layer for Stable Lithium Metal Anode. *Adv. Energy Mat.* **2019**, *9*, 1900858.  
DOI: [10.1002/aenm.201900858](https://doi.org/10.1002/aenm.201900858)
5. Huang, W.\*; **Boyle, D. T.\***; Li, Y.; Li, Y.; Pei, A.; Chen, H.; Cui, Y. Nanostructural and Electrochemical Evolution of the Solid-electrolyte Interphase on CuO Nanowires Revealed by Cryogenic Electron Microscopy and Impedance Spectroscopy. *ACS Nano* **2019**, *13* (1), 737-744.  
DOI: [10.1021/acs.nano.8b08012](https://doi.org/10.1021/acs.nano.8b08012)
4. Deponte, M. C.; Wilke, J. A.; **Boyle, D. T.**; Gillum, M. Z.; Schlosser, D. A.; Lam, V. H.; Kaleem, H.; Maxwell, E. M.; Baber, A. E. Low–Temperature Exchange of Hydrogen and Deuterium between Molecular Ethanol and Water on Au(111). *Surface Science* **2018**, *680*, 1-5.  
DOI: [10.1016/j.susc.2018.10.001](https://doi.org/10.1016/j.susc.2018.10.001)
3. Li, Y.\*; Huang, W.\*; Li, Y.\*; Pei, A.; **Boyle, D. T.**; Cui, Y. Correlating Structure and Function of Battery Interphases at Atomic Resolution with Cryoelectron Microscopy. *Joule* **2018**, *2* (10), 2167-2177.  
DOI: [10.1016/j.joule.2018.08.004](https://doi.org/10.1016/j.joule.2018.08.004)
2. Shi, F.; Pei, A.; **Boyle, D. T.**; Xie, J.; Yu, X.; Zhang, X.; Cui, Y. Lithium Metal Stripping Beneath the Solid Electrolyte Interphase. *Proc. Nat. Acad. Sci.* **2018**, *115* (34), 8529-8534.  
DOI: [10.1073/pnas.1806878115](https://doi.org/10.1073/pnas.1806878115)
1. **Boyle, D. T.**; Wilke, J. A.; Palomino, R. M.; Lam, V. H.; Schlosser, D. A.; Andahazy, W. J.; Stopak, C. Z.; Stacchiola D. J., Rodriguez, D. J.; Baber, A. E. Elucidation of Active Sites for the Reaction of Ethanol on TiO<sub>2</sub>/Au(111). *J. Phys. Chem. C* **2017**, *121* (14), 7794-7802.  
DOI: [10.1021/acs.jpcc.6b11764](https://doi.org/10.1021/acs.jpcc.6b11764)

\*Co-first authors

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## Research Experience

*Stanford University* – Advisor: Prof. Yi Cui

2017- Present Stanford, CA

Physical Electrochemistry of Lithium Metal Anodes

- Showed that the electron-transfer kinetics of lithium metal anodes are consistent with the framework of Marcus Theory using transient voltammetry with ultramicroelectrodes
- Correlated the nanostructure of lithium battery interphases to macroscopic electrochemical impedance measurements during the voltage-dependent formation of the interphase

*James Madison University* – Advisor: Prof. Ashleigh Baber

2014-2017 Harrisonburg, VA

Adsorption and Chemistry of Ethanol on Au(111) and TiO<sub>2</sub>/Au(111) Model Catalysts

- Constructed and maintained a thermal desorption ultrahigh vacuum chamber

- Used temperature programmed desorption (TPD) and surface characterization methods to understand the role of distinct surface sites on ethanol adsorption and chemistry on Au(111) & TiO<sub>2</sub>/Au(111)
- Designed experiments and established the research direction of the lab
- Trained and mentored new members of the lab

*Colorado State University* – Advisor: Prof. James Neilson

2016 Fort Collins, CO

Formation Pathways of Copper Oxides with Low-Temperature Metathesis

- Used air-free synthetic techniques and powder X-ray diffraction (PXRD) to investigate the solid-state formation pathway of copper oxides

## Selected Presentations

4. **Boyle, D. T.**, Wilke, J. A., Lam, V. H., Baber, A. E. *253rd ACS National Meeting*, “Elucidating distinct Au(111) and TiO<sub>2</sub>/Au(111) surface sites for the selective oxidation of ethanol to acetaldehyde”; San Francisco, CA, April 2, **2017**; poster.
3. **Boyle, D. T.**, Wilke, J. A., Lam, V. H., Baber, A. E. *68th Southeast Regional Meeting of the American Chemical Society*, “Low temperature adsorption of ethanol on TiO<sub>2</sub>/Au(111) inverse model catalysts”; Columbia, SC, October 25, **2016**; oral.
2. **Boyle, D. T.**, Martinolich, A. J., Neilson, J. R. *68th Southeast Regional Meeting of the American Chemical Society*, “Understanding the formation of copper (II) oxide through solid-state metathesis”; Columbia, SC, October 24, **2016**; poster.
1. **Boyle, D. T.**, Andahazy, W. J., Stopak, C. Z., Lam, V. H., Schlosser, D. A., Boeckmann, D., Baber, A. E. *251st ACS National Meeting*, “Adsorption and Reactivity of Ethanol on Au(111)-Based Inverse Model Catalysts”; San Diego, CA, March 14, **2016**; poster.

## Teaching/Mentoring Experience

*Stanford University*

Stanford, CA

Graduate Teaching Assistant

2017-2018

- CHEM 151: Inorganic Chemistry I
- CHEM 2&3: Organic Chemistry II & III
- CHEM 31X: Chemical Principles Accelerated

*James Madison University*

Harrisonburg, VA

Teaching Assistant

Spring 2016

- CHEM 270: Inorganic Chemistry I

## Lab and Software Experience

*Working experience with instrumentation:*

- Thermal gravimetric analysis (TGA), infrared spectroscopy (FT-IR, ATR-IR), nuclear magnetic resonance spectroscopy (<sup>1</sup>H, <sup>13</sup>C, <sup>31</sup>P NMR), photolithography, UV-Vis & fluorescence spectroscopy, gas chromatography (GC), mass spectrometry (GC-MS, TPD), and high-performance liquid chromatography (HPLC), atomic force microscopy (AFM), Auger electron spectroscopy (AES), X-ray photoelectron spectroscopy (XPS), scanning electron microscopy (SEM), cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS)

*Software experience:*

- Fluent with Python Programming Language (SciPy, NumPy, Matplotlib) and MATLAB
- Fluent with SciFinder, Scopus, Mendeley, and RefWorks
- Fluent in OriginPro 9.1 graphing software
- Grace plotting software

*Workshops:*

- Extreme Crystals Weekend Workshop
  - o University of Nevada Las Vegas High Pressure Science and Engineering Center (HiPSEC)