Justin G. Connell, Ph.D.

Argonne National Laboratory ◆ Joint Center for Energy Storage Research
University of Chicago ◆ Pritzker School of Molecular Engineering ◆ Consortium for Advanced Science and Engineering
9700 S Cass Ave. ◆ Lemont, IL 60439

Summary of Qualifications

- 15+ years of applied and fundamental research experience in energy conversion/storage and optoelectronic materials
- Extensive experience with vacuum synthesis of oxide, semiconductor and carbon nanomaterials and thin films, and the characterization of these materials using tomographic, spectroscopic and electron microsocopy-based techniques
- Demonstrated ability to work independently and as part of a group effort, both within a research group and as part of domestic and international collaborations
- Strong presentation and written communication skills, with extensive experience speaking to large groups of peers

Education

Northwestern University

- Doctor of Philosophy, Materials Science and Engineering **August 2013**
- Kellogg School of Management, Management for Scientists and Engineers Program **Summer 2012**

The College of William and Mary

- Bachelor's of Science in Chemistry, with a minor in Applied Science **May 2008**
- Graduated *cum laude*, with High Honors in Chemistry

Recent Research Experience

Materials Scientist, Joint Center for Energy Storage Research (JCESR), Argonne National Laboratory **2016-Present**
Supervisor: Dr. George Crabtree

- Management of the Electrochemical Discovery Laboratory, including coordination of external user research activities and collaborative outreach to the larger JCESR and Argonne community
- Electrochemical and spectroscopic investigation of interfacial stability of anode surfaces for beyond Li-ion battery technologies, including protected Li metal and multivalent anodes (Mg, Zn, etc…)
- Materials development and spectroscopic/electrochemical investigation of buried interfaces in oxide and sulfide-based solid electrolytes for all-solid-state batteries

Postdoctoral Researcher, Materials Science Division, Argonne National Laboratory **2013-2016**
Research Advisor: Dr. Nenad Markovic

- Managed the Electrochemical Discovery Laboratory and installed/operated a multi-module ultrahigh vacuum synthesis and characterization system
- Characterized magnesium deposition and stripping behavior in novel multivalent electrolyte systems using surface electroanalytical and spectroscopic techniques
- Synthesized thin film oxide cathode materials via magnetron sputtering for use as model systems for understanding the effects of defect structures on the performance of multivalent ion battery systems

PhD Candidate, Materials Science and Engineering, Northwestern University **2008-2013**
Research Advisor: Professor Lincoln Lauhon

- Synthesized silicon and germanium nanowires via low pressure thermal chemical vapor deposition for studies of the influence of the catalyst on dopant incorporation, as well as for use as functional optoelectronic materials
- Analyzed doped nanowire structures using atom probe tomography, with a focus on understanding dopant incorporation mechanisms as a means of controlling dopant distributions in nanowires

Publications (1729 total citations, *h*-index = 22)

Zorko, M.; Martins, P. F. B. D.; **Connell, J. G.**; Lopes, P. P.; Markovic, N. M.; Stamenkovic, V. R.; Strmcnik, D. Improved rate for the oxygen reduction reaction in sulfuric acid electrolyte by Pt(111) surface modified with self-assembled melamine. *ACS Applied Materials & Interfaces* (2021). doi: 10.1021/acsami.0c18167

Connell, J. G.[†]; Fuchs, T.[†]; Hartmann, H.; Krauskopf, T.; Zhu, Y.; Sann, J.; Garcia-Mendez, R.; Sakamoto, J.; Tepavcevic, S.; Janek, J. Kinetic versus Thermodynamic Stability of LLZO in Contact with Lithium Metal. *Chemistry of Materials* **32** (2020) 10207-10215.

Connell, J. G.; Zorko, M.; Agarwal, G.; Liao, C.; Assary, R. S.; Strmcnik, D.; Markovic, N. M. Anion Association Strength as a Unifying Descriptor for the Reversibility of Divalent Metal Deposition. *ACS Applied Materials & Interfaces* **12** (2020) 36137–36147.

Yang, J.; Shkrob, I.; Liu, K.; **Connell, J.**; Dietz-Rago, N. L.; Zhang, Z.; Liao, C. 4-(Trimethylsilyl) Morpholine as a Multifunctional Electrolyte Additive in High Voltage Lithium Ion Batteries. *Journal of the Electrochemical Society* **167** (2020) 070533.

Behar, D.; Rajh, T.; Liu, Y.; **Connell, J.**; Stamenkovic, V.; Rabani, J. Unusual reduction of graphene oxide by titanium dioxide electrons produced by ionizing radiation. Reaction products and mechanism. *Journal of Physical Chemistry C* **124** (2020) 5425-5435.

Cermeneka, B.; Genorio, B; Wintera, T.; Wolfa, S.; **Connell, J. G.**; Roschgera, M.; Letofsky-Papstd, I.; Kienzle, N.; Bitshnauf, B.; Hacker, V. Alkaline Ethanol Oxidation Reaction on Carbon Supported Ternary PdNiBi Nanocatalyst using Modified Instant Reduction Synthesis Method. *Electrocatalysis* **11** (2020) 203-214.

Genorio, B.; Harrison, K. A.; **Connell, J. G.**; Drazic, G.; Zavadil, K. R.; Markovic, N. M.; Strmcnik, D. Tuning the Selectivity and Activity of Electrochemical Interfaces with Defective Graphene Oxide and Reduced Graphene Oxide. *ACS Applied Materials & Interfaces* **11** (2019) 34517-34525.

Lau, K.-C.; Seguin, T. J.; Carino, E. V.; Hahn, N. T.; **Connell, J. G.**; Ingram, B. J.; Persson, K. A.; Zavadil, K. A.; Liao, C. Widening Electrochemical Window of Mg Salt by Weakly Coordinating Perfluoroalkoxyaluminate Anion for Mg Battery Electrolyte. *Journal of the Electrochemical Society* **166** (2019) A1510-A1519.

Zhu, Y.; **Connell, J. G.**; Tepavcevic, S.; Zapol, P.; Garcia-Mendez, R.; Taylor, N. J.; Sakamoto, J.; Ingram, B. J.; Curtiss, L. A.; Freeland, J. W.; Fong, D. D.; Markovic, N. M. Dopant-Dependent Stability of Garnet Solid Electrolyte Interfaces with Lithium Metal. *Advanced Energy Materials* **9** (2019) 1803440.

Tepavcevic, S.; **Connell, J. G.**; Lopes, P. P.; Bachhav, M.; Key, B.; Valero-Vidal, C.; Crumlin, E. J.; Markovic, N. M. Role of Structural Hydroxyl Groups in Enhancing Performance in Electrochemically-Synthesized Bilayer V_2O_5. *Nano Energy* **53** (2018) 449-457.

Connell, J. G.; Zhu, Y.; Zapol, P.; Tepavcevic, S.; Sharafi, A.; Sakamoto, J.; Curtiss, L. A.; Fong, D. D.; Freeland, J. W.; Markovic, N. M. Crystal Orientation-Dependent Reactivity of Oxide Surfaces in Contact with Lithium Metal. *ACS Applied Materials & Interfaces* **10** (2018) 17471-17479.

Lopes, P. P.; Zorko, M.; Hawthorne, K. L.; **Connell, J. G.**; Ingram, B. J.; Strmcnik, D.; Stamenkovic, V. R.; Markovic, N. M. Real-Time Monitoring of Cation Dissolution/De-Intercalation Kinetics from Transition Metal Oxides in Organic Environments. *Journal of Physical Chemistry Letters* **9** (2018) 4935-4940.

Strmcnik, D.; Castelli, I. E.; **Connell, J. G.**; Haering, D.; Zorko, M.; Martins, P.; Lopes, P. P.; Genorio, B.; Østergaard, T.; Gasteiger, H.; Maglia, F.; Antonopoulos, B. K.; Stamenkovic, V. R.; Rossmeisl, J.; Markovic, N. M. Electrocatalytic transformation of impurity HF to H_2 and LiF in lithium ion batteries. *Nature Catalysis* **1** (2018) 255-262.

[†] Indicates equal contribution

Li, L.; Pascal, T. A.; **Connell, J. G.**; Fan, F. Y.; Meckler, S. M.; Ma, L.; Chiang, Y.-M.; Prendergast, D.; Helms, B. A. Molecular Understanding of Polyelectrolyte Binders that Actively Regulate Ion Transport in Sulfur Cathodes with High Areal Sulfur Loadings. *Nature Communications* **8** (2017) 2277.

Lau, K.-C.; Dietz Rago, N. L.; **Connell, J. G.**; Hu, B.; Zhang, L.; Zhang, Z; Liao, C. Improved Performance through Tight Coupling of Redox Cycles of Sulfur and 2,6-Polyanthraquinone in Lithium-Sulfur Batteries. *Journal of Materials Chemistry A* **5** (2017) 24103-24109.

Carino, E. V.; Newman, D. J.; **Connell, J. G.**; Kim, C.; Brushett, F. R. Early Stage Anodic Instability of Glassy Carbon Electrodes in Propylene Carbonate Solvent Containing Lithium Hexafluorophosphate. *Langmuir* **33** (2017) 11911-11918.

Adams, B. D.; Carino, E. V.; **Connell, J. G.**; Han, K. S.; Cao, R.; Chen, J.; Zheng, J.; Li, Q.; Henderson, W. A.; Mueller, K. T.; Zhang, J.-G. Long Term Stability of Li-S Batteries Using High Concentration Lithium Nitrate Electrolytes. *Nano Energy* **40** (2017) 607-617.

Deng, C.; Lau, M. L.; Barkholtz, H.; Xu, H.; Parrish, R.; Xu, M.; Xu, T.; Liu, Y.; Wang, H.; **Connell, J. G.**; Smith, K.; Xiong, H. Amorphous Boron Nanorod as Anode Material for Lithium-ion Batteries at Room Temperature. *Nanoscale* **9** (2017) 10757-10763.

Chen, L.; **Connell, J. G.**; Nie, A.; Huang, Z.; Zavadil, K. R.; Klavetter, K. C.; Yuan, Y.; Sarifi-Asl, S.; Shahbazian-Yassar, R.; Libera, J. A.; Mane, A. U.; Elam, J. W. Lithium Metal Protected by Atomic Layer Deposition Metal Oxide for High Performance Anodes. *Journal of Materials Chemistry A* **5** (2017) 12297-12309.

Sohn, H.; Camacho-Bunquin, J.; Langeslay, R. R.; Ignacio-de Leon, P. A.; Niklas, J.; Poluektov, O. G.; Liu, C.; **Connell, J. G.**; Yang, D.; Kropf, J.; Kim, H.; Stair, P. C.; Ferrandon, M.; Delferro, M. Isolated, Well-Defined Organovanadium (III) on Silica: Single-Site Catalyst for Hydrogenation of Alkenes and Alkynes. *Chemical Communications* **53** (2017) 7325-7328.

Connell, J. G.; Genorio, B.; Lopes, P. P.; Strmcnik, D.; Stamenkovic, V. R.; Markovic, N. M. Tuning the Reversibility of Mg Anodes via Controlled Surface Passivation by H_2O/Cl^- in Organic Electrolytes. *Chemistry of Materials* **28** (2016) 8268-8277.

Lopes, P. P.; Strmcnik, D.; Tripkovic, D.; **Connell, J. G.**; Stamenkovic, V.; and Markovic, N. Relationships between Atomic Level Surface Structure and Stability/Activity of Platinum Surface Atoms in Aqueous Environments. *ACS Catalysis* **6** (2016) 2536-2544.

Genorio, B.; Jirkovský, J. S.; Assary, R.; **Connell, J. G.**; Strmcnik, D.; Diesendruck, C. E.; Stamenkovic, V. R.; Moore, J. S.; Curtiss, L.; and Markovic, N. M. Superoxide (electro)chemistry on well-defined surfaces in organic environments. *Journal of Physical Chemistry C* (2016) 15909-15914.

He, M.; Su, C.-C.; Peebles, C.; Feng, Z.; **Connell, J. G.**; Liao, C.; Wang, Y.; Shkrob, I. A.; Zhang, Z. Mechanistic Insight in the Function of Phosphite Additives for Protection of $LiNi_{0.5}Co_{0.2}Mn_{0.3}O_2$ Cathode in High Voltage Li-Ion Cells. *ACS Applied Materials & Interfaces* **8** (2016) 11450–11458.

Lopes, P. P.; Strmcnik, D.; Jirkovsky, J. S.; **Connell, J. G.**; Stamenkovic, V.; and Markovic, N. Double layer effects in electrocatalysis: the oxygen reduction reaction and ethanol oxidation reaction on Au(111), Pt(111) and Ir(111) in alkaline media containing Na and Li cations. *Catalysis Today* **262** (2015) 41-47.

Jirkovský, J. S.; Subbaraman, R.; Strmcnik, D.; Harrison, K. L.; Diesendruck, C. E.; Assary, R.; Frank, O.; Kobr, L.; Wiberg, G. K. H.; Genorio, B.; **Connell, J. G.**; Lopes, P. P.; Stamenkovic, V. R.; Curtiss, L.; Moore, J. S.; Zavadil, K. R.; and Markovic, N. M. Water as a promoter and catalyst for dioxygen electrochemistry in aqueous and organic media. *ACS Catalysis*, **5** (2015) 6600-6607.

van t' Erve, O. M. J.; Friedman, A. L.; Li, C. H.; Robinson, J. T.; **Connell, J.**; Lauhon, L. J.; Jonker, B. T. Spin transport and Hanle effect in silicon nanowires using graphene tunnel barriers. *Nature Communications*, **6** (2015) 7541.

Chang, S. H.; **Connell, J. G.**; Danilovic, N.; Subbaraman, R.; Chang, K.-C.; Stamenkovic, V. R.; Markovic, N. M. Activity-Stability Relationships in the Surface Electrochemistry of the Oxygen Evolution Reaction. *Faraday Discussions*, **176** (2014) 125-133.

Bernal, R. A.; Filleter, T.; **Connell, J. G.**; Sohn, K.; Huang, J.; Lauhon, L. J.; Espinosa, H. J. In-situ Electron Microscopy, Four-Point Electromechanical Characterization of Freestanding Metallic and Semiconducting Nanowires. *Small*, **10** (2014) 725-733.

Connell, J. G.; Yoon, K.; Perea, D. E,; Schwalbach, E. J.; Voorhees, P. W.; Lauhon, L. J. Identification of an Intrinsic Source of Doping Inhomogeneity in VLS-Grown Nanowires. *Nano Letters*, **13** (2013) 199-206.

Yoon, K.; Hyun, J.; **Connell, J. G.**; Amit, I.; Rosenwaks, Y.; Lauhon, L. J. Barrier Height Measurement of Metal Contacts to Si Nanowires Using Internal Photoemission of Hot Carriers. *Nano Letters*, **13** (2013) 6183-6188.

Meng, G.; Parent, L.; Mehdi, L.; Unocic, R.; McDowell, M.; Sacci, R.; Xu, W.; **Connell, J. G.**; Xu, P.; Abellan Baeza, P.; Chen, X.; Yaohui, Z.; Perea, D. E.; Lauhon, L. J.; Arslan, I.; Zhang, J.-G.; Liu, J.; Cui, Y.; Browning, N.; Wang, C. Demonstration of an Electrochemical Liquid Cell for Operando Transmission Electron Microscopy Observation of the Lithiation/Delithiation Behavior of Si Nanowire Battery Anodes. *Nano Letters*, **13** (2013) 6106-6112.

Wang, Z.; Gu, M.; Zhou, Y.; Zu, X.; **Connell, J. G.**; Xiao, J.; Perea, D. E.; Lauhon, L. J.; Wang, C.; Bang, J.; Zhang, S.; Gao, F. Electron-Rich Induced Electrochemical Solid State Amorphization. *Nano Letters*, **13** (2013) 4511-4516.

Gu, M.; Wang, Z.; **Connell, J. G.**; Perea, D. E.; Lauhon, L. J.; Gao, F; Wang, C.-M. Electronic Origin for the Phase Transition from Amorphous Li_xSi to Crystalline $Li_{15}Si_4$. *ACS Nano*, **7** (2013) 6303-6309.

Amit, I.; Givan, U., **Connell, J. G.**; Paul, D. F.; Hammond, J. S.; Lauhon, L. J.; Rosenwaks, Y. Spatially Resolved Correlation of Active and Total Doping Concentrations in VLS Grown Nanowires. *Nano Letters*, **13** (2013) 2598-2604.

Wu, J.; Padalkar, S.; Xie, S.; Hemesath, E. R.; Cheng, J.-P.; Liu, G.; Yan, A.; **Connell, J. G.**; Nakazawa, E.; Zhang, X.; Lauhon, L. J.; Dravid, V. P. Electron Tomography of Au-Catalyzed Semiconductor Nanowires. *Journal of Physical Chemistry C*, **117** (2013) 1059-1063.

Hyun, J. K.; Kim, I. S.; **Connell, J. G.**; Lauhon, L. J. Raman Concentrators in Ge Nanowires with Dielectric Coatings. *Optics Express*, **20** (2012) 5127–5132.

Lopez, F. J.; Givan, U.; **Connell, J. G.**; Lauhon, L. J. Silicon Nanowire Polytypes: Identification by Raman Spectroscopy, Generation Mechanism, and Misfit Strain in Homostructures. *ACS Nano*, **5** (2011) 8958–8966.

Zeiner, C.; Lugstein, A.; Burchart, T.; Pongratz, P.; **Connell, J. G.**; Lauhon, L. J.; Bertagnoli, E. Atypical Self-Activation of Ga Dopant for Ge Nanowire Devices. *Nano Letters*, **11** (2011) 3108-3112.

Connell, **J. G.**; Al Balushi, Z. Y.; Sohn, K.; Huang, J.; Lauhon, L. J. Growth of Ge Nanowires from Au-Cu Alloy Nanoparticle Catalysts Synthesized from Aqueous Solution. *Journal of Physical Chemistry Letters*, **1** (2010) 3360-3365.

Henry, B. L.; **Connell, J.**; Liang, A.; Krishnasamy, C.; Desai, U. R. Interaction of Antithrombin with Sulfated, Low Molecular Weight Lignins: Opportunities for Potent, Selective Modulation of Antithrombin Function. *Journal of Biological Chemistry*, **284** (2009) 20897-20908.

Conference & Seminar Presentations

Connell, J. G. (Invited Presentation) Anion Effects at Multivalent Anodes: Toward Common Descriptors for Designing New Magnesium Electrolytes. *3rd International Symposium on Magnesium Batteries.* Ulm, Germany (Virtual) **Sept. 2020.**

Connell, J. G. (Poster Presentation); Zhu, Y.; Tepavcevic, S.; Zapol, P.; Fong, D. D.; Garcia-Mendez, R.; Sakamoto, J.; Ingram, B. J.; Freeland, J. W.; Curtiss, L. A.; Markovic, N. M. Kinetic versus Thermodynamic Phenomena Guiding Interfacial Stability of Solid-State Electrolytes. *Batteries Gordon Research Conference*, **Feb. 2020.**

Connell, J. G. (Invited Presentation) Understanding (Electro)chemical Reactivity at Buried Interfaces in Energy Storage Systems. *American Chemical Society Great Lakes Regional Meeting.* **May 2019.**

Connell, J. G.; Genorio, B.; Lopes, P. P.; Strmcnik, D.; Stamenkovic, V. R.; Markovic, N. M. Impurity-Driven Anode Surface Chemistry in Electrolytes for Multivalent Ion Batteries. *232nd Electrochemical Society Meeting*. **Oct. 2017.**

Connell, J. G. 3D Composition Profiling at the Nanoscale: Doping Limits in Semiconducting Nanowires. *Center for Nanoscale Materials Division Seminar*, Host: Prof. Amanda Petford-Long. Argonne National Laboratory, **Jan. 2013.**

Connell, J. G.; Yoon, K.; Perea, D. E,; Schwalbach, E. J.; Voorhees, P. W. & Lauhon, L. J. Facet-Dependent Dopant Incorporation in VLS-Grown Nanowires. *Materials Research Society Fall Meeting*, **Nov. 2012.**

Connell, J. G.; Al Balushi, Z. Y.; Sohn, K.; Huang, J.; Lauhon, L. J. Growth of Ge Nanowires from Au-Cu Alloy Nanoparticle Catalysts Synthesized from Aqueous Solution. *Materials Research Society Spring Meeting*, **April 2011.**

Connell, J. G.; Al Balushi, Z. Y.; Sohn, K.; Huang, J.; Lauhon, L. J. The Influence of the Catalyst on Dopant Incorporation and Growth of Ge Nanowires. *Electronic Materials Conference*, **June 2010.**

Honors & Awards

American Vacuum Society Speaker Award, Hilliard Symposium, *Northwestern University*	**2013**
Cabell Terminal Year Fellowship, *Northwestern University*	**2012**
Hierarchical Materials Cluster Program Fellowship, *Northwestern University*	**2009**
American Institute of Chemists Foundation Award	**2008**
Physics Research Experience for Undergraduates Program, *The College of William and Mary*	**2006**
William and Mary Scholar Award, *The College of William and Mary*	**2004**
Monroe Scholarship, *The College of William and Mary*	**2004**

Skills

Synthetic Techniques:	magnetron sputtering, molecular beam epitaxy, chemical vapor deposition (thermal and plasma-enhanced), electron beam evaporation, aqueous nanocrystal synthesis
Microscopy/Microanalysis:	X-ray photoelectron spectroscopy, Auger electron spectroscopy, ultraviolet photoelectron spectroscopy, low energy electron diffraction, low energy ion scattering, three-dimensional atom probe tomography, transmission electron microscopy (scanning and conventional), scanning electron microscopy, energy-dispersive X-ray spectroscopy, electron energy loss spectroscopy, time of flight mass spectrometry
Electrochemical Analysis:	Rotating (ring) disk voltammetry, bulk electrolysis
Software:	Igor Pro, Origin, Digital Micrograph, IVAS (APT Analysis), Inca/Aztec (EDS Analysis), Illustrator, Photoshop, LaTeX, Microsoft Office Suite