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Nicholas Faenza, Ph.D., P.E., CFEI

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Professional Profile

Dr. Faenza is a materials engineer who specializes in energy storage technologies and product safety assessments for multiple industries. At Exponent, he provides technical expertise to lead failure analysis investigations, support design evaluations, and resolve complex technical issues involving battery safety and performance.

Over his career, Dr. Faenza has developed a specialization in thermal abuse testing and risk assessments of lithium-ion batteries of various chemistries, sizes, and formats. With this expertise, he has led battery evaluations and product re-designs in multiple industries from consumer electronics to automotive and grid storage applications. In these efforts, he often works with his clients to provide design-focused experiments coupled with advanced analytical techniques to elucidate potential failure mechanisms and to assess and prepare against failure scenario hazards. In his work, Dr. Faenza has led complex investigations involving consumer electronic and medical device recalls, research and development programs for critical safety features, and in assessing safety hazards for electric vehicle battery pack designs. Dr. Faenza uses his diverse technical capabilities to understand the fundamental mechanisms causing failures and to assist in developing applicable solutions and risk assessments.

Dr. Faenza is recognized for his skill in multiple physical, structural, and electrochemical characterization methods, as well as in designing customized testing programs. He uses this expertise to evaluate material and product performance as well as to identify the root causes of failure for electronic products, medical devices, and electric vehicles.

Prior to joining Exponent, Dr. Faenza's graduate research focused on investigating the structural and chemical degradation mechanisms for positive electrode materials at high states of charge. He also led a thorough analysis of the surface impurity species that develop on state-of-the-art electrode materials and their impact on the material's electrochemical performance. During this time he developed material fabrication experience which is founded in hydrothermal co-precipitation synthesis, and encompasses the use of a variety of thermal and powder processing techniques. He is experienced with numerous analytical techniques including; X-ray computed tomography (CT), X-ray diffraction (XRD), microcalorimetry, thermogravimetric analysis (TGA), Fourier transform infrared spectroscopy (FTIR), and others. Prior to graduate school, Dr. Faenza developed graphene and silicon-based electrodes and also worked on reducing the flammability of polyurethane foam at the National Institute of Standards and Technology (NIST).

Academic Credentials & Professional Honors

Ph.D., Materials Science and Engineering, Rutgers University, 2018

B.S., Materials Science and Engineering, University of Maryland, College Park, 2013

Journal of the Electrochemical Society Editor's Choice Article, 2017

Department of Materials Science & Engineering Outstanding Materials Student Service Award, 2013

Licenses and Certifications

Professional Engineer Metallurgical, Arizona, #81093

Professional Engineer Metallurgical, California, #2011

Certified Fire and Explosion Investigator (CFEI)

Professional Affiliations

National Association of Fire Investigators

The Electrochemical Society

Publications

D. Torelli, N. Faenza, P. Johns, S. Lawton, and J. Frake, Evaluation of Fire Spread and Suppression Techniques in Micro-Mobility Battery Packs, ECS Advances, (2024)

N. Faenza, R. Spray, M. Kuykendal, Understanding the Fundamental Mechanisms of Battery Thermal Runaway Propagation and Mitigation, SAE Technical Paper 2023-01-1515, (2023)

M. Wolfman, B. May, V. Goel, S. Du, Y-S. Yu, N. Faenza, N. Pereira, K. Wiaderek, R. Xu, J. Wang, G. G. Amatucci, K. Thornton, J. Cabana, Origin of Rapid Delithiation In Secondary Particles of LiNi0.8Co0.15Al0.05O2 and LiNiyMnzCo1-y-zO2 Cathodes, ChemRxiv¸ (2023).

P. Mukherjee, P. Lu, N. Faenza, N. Pereira, G. G. Amatucci, G. Ceder, F. Cosandey, Atomic Structure of Surface-Densified Phases in Ni-rich Layered Compounds, ACS Applied Materials & Interfaces, 13, (2021), pg. 17478-17486.

M, Wolfman, Y-S Yu, B. May, Z. Lebens-Higgins, S. Sallis, N. Faenza, N. Pereira, N. Shirato, V. Rose, D. Shapiro, G. G. Amatucci, L. F. J. Piper, and J. Cabana, Mapping Competitive Reduction upon Charging in LiNi0.8Co0.15Al0/05O2 Primary Particles, Chemistry of Materials, 14, (2020), pg. 6161-6175.

Z, Lebens-Higgins, H. Chung, M. Zuba, J. Rana, Y. Li, N. Faenza, N. Pereira, B. D. McCloskey, F. Rodolakis, W. Yang, S. Whittingham, G.G. Amatucci, Y. S. Meng, T. Lee, and L.F.J Piper, How Bulk Sensitive is Hard X-ray Photoelectron Spectroscopy: Accounting for the Cathode-Electrolyte Interface When Addressing Oxygen Redox, J. Phys. Chem. Letters., 11, (2020), pg. 2106-2112.

Z. Lebens-Higgins, D. Halat, N. Faenza, M. Wahila, M. Mascheck, T. Wiell, S. Eriksson, P. Palmgresun, J. Rodriguez, F. Badway, N. Pereira, G. G. Amatucci, T. Lee, C. Grey, L. F. J. Piper, Surface Chemistry Dependence on Aluminum Doping in Ni-rich LiNi0.8Co0.2-yAlyO2 Cathodes, Nature Scientific Reports, (2019).

Z. Lebens-Higgins, N. Faenza, M. Radin, H. Liu, S. Sallis, J. Rana, J. Vinckeviciute, P. Reeves, M. Zuba, F. Badway, N. Pereira, K. Chapman, T-L. Lee, T. Wu, C.P. Grey, B. Melot, A. Van der Ven, G. G. Amatucci, W. Yang, and L. F. J. Piper, Revisiting the charge compensation mechanisms in LiNi0.8Co0.2-yAlyO2 systems, Materials Horizons, (2019).

Z. Lebens-Higgins, J. Vinckeviciute, J. Wu, N. Faenza, Y. Li, S. Sallis, N. Pereira, Y. Shirley Meng, G.G.

Amatucci, A. Van der Ven, W. Yang, L. F. J. Piper, Distinction Between Intrinsic and X-ray Induced Oxidized Oxygen States in Li-Rich 3d Layered Oxides and LiAlO2, The Journal of Physical Chemistry C, (2019).

J. Vinckeviciute, M. Radin, N. Faenza, G.G. Amatucci, and A. Van der Ven, Fundamental insights about interlayer cation migration in Li-ion electrodes at high states of charge, Journal of Materials Chemistry A, (2019).

P. Mukherjee, N. Faenza, N. Pereira, J. Ciston, L. Piper, G. G. Amatucci, and F. Cosandey, Surface Structural and Chemical Evolution of Layered LiNi0.8Co0.15Al0.05O2 (NCA) Under High Voltage and Elevated Temperature Conditions, Chemistry of Materials, 30, pg. 8431-8445, (2018).

P. Mukherjee, N. Faenza, N. Pereira, G. G. Amatucci, and F. Cosandey, Equivalence of Three Seemingly Different Phases of Ni-rich Li-ion Battery Cathodes - New Insights Using Combined STEM and EELS Study, Microscopy and Microanalysis, 24, pg. 1502-1503 (2018).

Z. Lebens-Higgins, S. Sallis, N. Faenza, F. Badway, N. Pereira, D. Halat, M. Wahila, C. Schlueter, T-L. Lee, W. Yang, C. Grey, G. Amatucci, and L. Piper, Evolution of the Electrode-Electrolyte Interface of LiNi0.8Co0.15Al0.05O2 Electrodes Due to Electrochemical and Thermal Stress, Chemistry of Materials, 30 pg. 958-969 (2018).

N. Faenza, N. Pereira, D.M. Halat, J. Vinckeviciute, L. Bruce, M. Radin, P. Mukherjee, F. Badway, A. Halajko, F. Cosandey, C. P. Grey, A. Van der Ven, and G. G. Amatucci, The Phase Evolution and Degradation Modes of R$\bar{3}$m LixNi1-y-zCoyAlzO2 Electrodes Cycled Near Complete Delithiation, Chemistry of Materials, (2018).

(Editors' Choice) N. Faenza, Lejandro Bruce, Zachary W. Lebens-Higgins, Irene Plitz, Nathalie Pereira, Louis F. J. Piper, and Glenn G. Amatucci, Growth of Ambient Induced Surface Impurity Species on Layered Positive Electrode Materials and Impact on Electrochemical Performance, Journal of the Electrochemical Society, 164 (2017) A3727-A3741.

(Invited) N. Faenza, Z. Lebens-Higgins, P. Mukerjee, S. Sallis, N. Pereira, F. Badway, A. Halajko, G. Ceder, F. Cosandey, L. Piper, and G. G. Amattuci, Electrolyte-Induced Surface Transformation and Transition-Metal Dissolution of Fully Delithiated LiNi0.8Co0.15Al0.05O2, Langmuir 33 (2017) 9333-9353.

Z. W. Lebens-Higgins, N. V. Faenza, P. Mukherjee, S. Sallis, F. Badway, N. Pereira, C. Schlueter, T.-L. Lee, F. Cosandey, G. G. Amatucci, and L. F. J. Piper, Electrochemical and Thermal Stress of LiNi0.8Co0.15Al0.05O2 Electrodes: Evolution of Aluminum Surface Environments, ECS Transactions, 80 (10) pg. 197-206 (2017).

S. Sallis, N. Pereira, P. Mukherjee, N.F. Quackenbush, N. Faenza, C. Schuleter, T. Lee, W. L Yang, F. Cosandey, G. G. Amatucci, L. Piper, Surface degradation of Li1-xNi0.8Co0.15Al0.05O2 cathodes: Correlating charge transfer impedance with surface phase transformations, Applied Physics Letters, 108 (2016).

J. Wan, A. Kaplan, J. Zheng, X. Han, Y. Chen, N. Weadock, N. Faenza, S. Lacey, T. Li, J. Guo, and L. Hu, Two dimensional silicon nanowalls for lithium ion batteries, Journal of Materials Chemistry A, 17 (2014).

Presentations

N. Faenza, Understanding the Fundamental Mechanisms of Battery Thermal Runaway Propagation and Mitigation, NASA-SAE Energy & Mobility Conference, Cleveland, OH, September 15, 2023.

N. Faenza, Multifaceted Approach to Battery System Safety, National Academy of Engineers, Frontiers of Engineering Symposium, Bled, Slovenia, October, 2022.

N. Faenza, Safety Considerations For Advanced Cathode Materials, Cathode Sumit, May 25th, 2022.

N. Faenza, K. Beers, T. Bogart, J. Harding, How Do You Choose A Battery Manufacturer For Your Device? Part 1: Cell Qualification, Exponent Live Webinar, February 18, 2021.

N. Faenza, L. Bruce, Z. W. Lebens-Higgins, I. Plitz, N. Pereira, L. F. J. Piper and G. G. Amatucci, Surface Impurities on Layered Positive Electrode Materials: Mechanism for Formation and Impact on Performance, Laboratory for Surface Modification/Institute for Advanced Materials, Devices and Nanotechnology Symposium, New Brunswick, NJ, USA, February 27th 2018.

N. Faenza, P. Mukherjee, S. Sallis, N. Pereira, H. Das, G. Ceder, L. Piper, F. Cosandey, and G. G. Amatucci, Dynamic Transformations of Layered Compounds at Full Delithiation Due to Surface Triggered Reactions, Electrochemical Society PRIME Conference, Honolulu, HI, USA, October 6th 2016.

N. Faenza, Y. Li, and R. Davis, Multi-Substrate Flammability Reduction Using a Layer-by-Layer Assembly with Natural Materials, National Institute of Standards and Technology SURF Symposium, Gaithersburg, MD, USA, August 2013.

N. Faenza, Y. Li, Y. Kim, and R. Davis, Reduced Flammability of Polyurethane Foam Using a Layer-by-Layer Assembly with Natural Materials, National Institute of Standards and Technology SURF Symposium, Gaithersburg, MD, USA, August 2012.

N. Faenza, L. Bruce, Z. W. Lebens-Higgins, I. Plitz, N. Pereira, L. F. J. Piper, and G. G. Amatucci, Surface Impurities on Layered Positive Electrode Materials-Mechanisms for Formation and Impact on Perofrmance, Materials Research Society Fall Conference, Boston, MA, US, November 2017.

N. Faenza, Z. Lebens-Higgins, P. Mukherjee, S. Sallis, F. Badway, A. Halajko, N. Pereira, G. Ceder, F. Cosandey, L. Piper, and G. G. Amatucci, NECEES: Electrochemically Initiated Surface Chemistries Inhibiting the Realization of the Theoretical Capacity of LiNi0.8Co0.15Al0.05O2, Department of Energy, Energy Frontier Research Center, Midterm Review, July 2017.

N. Faenza, S. Sallis, P. Mukherjee, H. Das, A. Urban, N. Pereira, L. Piper, F. Cosandey, G. Ceder and G. G. Amatucci, Understanding Cathode-Electrolyte Reactions via Microcalorimetry, NorthEast Center for Chemical Energy Storage Summer Meeting, June 29th 2016.

N. Faenza and G. G. Amatucci, Understanding Cathode-Electrolyte Reactions via Microcalorimetry, NorthEast Center for Chemical Energy Storage Fall Meeting, October 2015.