Exponent®
Engineering & Scientific Consulting

Jon Harding, Ph.D., P.E.

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Professional Profile

Dr. Harding is trained as a chemical engineer and has years of experience investigating the behaviors, chemistry, and failure modes of a variety of battery systems. Dr. Harding has experience in designing, conducting, and analyzing laboratory experiments related to abuse and/or accelerated aging of batteries to assist his clients in understanding how their batteries will perform in the field. In addition, Dr. Harding regularly conducts failure analysis of batteries after performance or thermal failures, relying on his experience, education, and a suite of analytical techniques to investigate the root cause of battery failures in the field.

To complete his analysis of such systems, Dr. Harding uses techniques including electrochemical impedance spectroscopy (EIS), reference electrode testing, analysis of cycling performance, X-ray analysis [X-ray powder diffraction (XRD), X-ray photoelectron spectroscopy (XPS), and computed tomography (CT)], cross-sectioning, and device teardowns. Dr. Harding has conducted numerous battery abuse tests including (but not limited to) nail penetration, forced internal short circuit, projectile testing, and customized mechanical abuse. Dr. Harding is experienced with several programming languages and uses these to control equipment, perform programmatic analysis, and visualize large data sets.

Prior to joining Exponent, Dr. Harding was a graduate research assistant in the Department of Chemical Engineering at the Massachusetts Institute of Technology. He worked in the Electrochemical Energy Lab and the Hammond Lab to develop a polymer electrolyte-based lithium–oxygen battery, and additionally investigated the efficacy of catalysts for the oxygen-evolution reaction in nonaqueous lithium–oxygen batteries. Over the course of this work, Dr. Harding designed and constructed a differential electrochemical mass spectrometer to characterize the consumption and production of gases in these devices. Dr. Harding obtained his Masters in Chemical Engineering Practice in 2012 based on engineering consulting work performed at Novartis in Basel, Switzerland and at SGC Energia in Güssing, Austria.

Academic Credentials & Professional Honors

Ph.D., Chemical Engineering, Massachusetts Institute of Technology (MIT), 2015

M.S., Chemical Engineering, Massachusetts Institute of Technology (MIT), 2012

B.S., Chemical Engineering, North Carolina State University, 2008

MIT Energy Initiative Fellow

Valedictorian, NC State, class of 2008

Eagle Scout

Licenses and Certifications

Professional Engineer Chemical, California, #6930

Prior Experience

Graduate Research Assistant, Massachusetts Institute of Technology, 2009-2015

Graduate Teaching Assistant, Massachusetts Institute of Technology, 2012

Undergraduate Research Assistant, NC State University, 2007-2009

Professional Affiliations

The Electrochemical Society—ECS

The American Chemical Society—ACS

Languages

German

Publications

Harding, J. R., Han, B., Madden, S. B. & Horn, Q. C. Examining the Performance of Implantable-Grade Lithium-Ion Cells after Overdischarge and Thermally Accelerated Aging. Energies 15, 1405 (2022). doi:10.3390/en15041405

Harding, J. R., Amanchukwu, C. V., Hammond, P. T. & Shao-Horn, Y. Instability of Poly(ethylene oxide) upon Oxidation in Lithium-Air Batteries. The Journal of Physical Chemistry C 119, 6947-6955 (2015). doi:10.1021/jp511794g

Harding, J. R., Lu, Y.-C., Tsukada, Y. & Shao-Horn, Y. Evidence of catalyzed oxidation of Li2O2 for rechargeable Li-air battery applications. Phys. Chem. Chem. Phys. 14, 10540-10546 (2012). doi:10.1039/C2CP41761H

Han, B., Harding, J. R., Goodman, J. S. K., Cai, Z., & Horn, Q.C. End-of-Charge Temperature Rise and State-of-Health Evaluation of Aged Lithium-Ion Battery. Energies 16, 506 (2023). doi:10.3390/en16010405

Zhu, J., Li, W., Wierzbicki, T., Xia, Y. & Harding, J. Deformation and failure of lithium-ion batteries treated as a discrete layered structure. International Journal of Plasticity 121, 293-311 (2019). doi:10.1016/j.ijplas.2019.06.011

Amanchukwu, C. V., Harding, J. R., Shao-Horn, Y. & Hammond, P. T. Understanding the Chemical Stability of Polymers for Lithium-Air Batteries. Chem. Mater. (2014). doi:10.1021/cm5040003

Lee, S. H., Harding, J. R., Liu, D. S., D'Arcy, J. M., Shao-Horn, Y. & Hammond, P. T. Li-Anode Protective Layers for Li Rechargeable Batteries via Layer-by-Layer Approaches. Chem. Mater. 26, 2579-2585 (2014). doi:10.1021/cm404154u

Lu, Y.-C., Gallant, B. M., Kwabi, D. G., Harding, J. R., Mitchell, R. R., Whittingham, M. S. & Shao-Horn, Y. Lithium-oxygen batteries: bridging mechanistic understanding and battery performance. Energy Environ. Sci. 6, 750-768 (2013). doi:10.1039/C3EE23966G

Lu, Y.-C., Crumlin, E. J., Veith, G. M., Harding, J. R., Mutoro, E., Baggetto, L., Dudney, N. J., Liu, Z. & Shao-Horn, Y. In Situ Ambient Pressure X-ray Photoelectron Spectroscopy Studies of Lithium-Oxygen Redox Reactions. Sci. Rep. 2, (2012). doi:10.1038/srep00715

Lu, Y.-C., Kwabi, D. G., Yao, K. P. C., Harding, J. R., Zhou, J., Zuin, L. & Shao-Horn, Y. The discharge rate capability of rechargeable Li-O2 batteries. Energy Environ. Sci. 4, 2999-3007 (2011). doi:10.1039/C1EE01500A

Tang, C., Saquing, C. D., Harding, J. R. & Khan, S. A. In Situ Cross-Linking of Electrospun Poly(vinyl alcohol) Nanofibers. Macromolecules 43, 630-637 (2009). doi:10.1021/ma902269p

Talwar, S., Harding, J., Oleson, K. R. & Khan, S. A. Surfactant-Mediated Modulation of Hydrophobic Interactions in Associative Polymer Solutions Containing Cyclodextrin. Langmuir 25, 794-802 (2008). doi:10.1021/la803056e

Presentations

Harding JR, Lu Y-C Hammond PT, Shao-Horn Y. Investigations of Li-O2 batteries using polyethylene oxide in three-phase electrodes metal-air batteries. 2012 PRiME Pacific Rim Meeting on Electrochemical and Solid-State Science, Honolulu, HI, October 9, 2012.

Harding JR, Lu Y-C, Tsukada Y, Shao-Horn Y. The influence of catalysts on electro-oxidation activity of lithium peroxide/oxide for lithium-air batteries. Mobile Energy, 2011 MRS Fall Meeting & Exhibit, Boston, MA, November 30, 2011.

Harding JR, Talwar S, Khan SA. Manipulating hydrophobic interactions in associative polymer solutions via surfactant-cyclodextrin complexation. ACS Colloid & Surface Science Symposium, Raleigh, NC, June 15-18, 2008.