



Exponent[®]
Engineering & Scientific Consulting

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Professional Profile

Dr. Beers's areas of expertise include failure analysis of batteries and polymer materials, battery technology, and polymer science. He has significant expertise and experience in the design, qualification, performance, reliability, safety, and failure analysis of batteries of varying formats, chemistries, and applications - with particular emphasis on lithium-ion, solid state, and secondary lithium metal battery chemistries. Additionally, he has specialized understanding of polymer materials used in electrochemical and filtration systems, and the associated transport phenomena. He has extensive experience applying his expertise in solving complex technical problems for his clients in a variety of industries including consumer products, medical devices, vehicles, and military and industrial equipment.

In his battery consulting practice, Dr. Beers assists clients with issues related to the full life cycle of battery-containing products, ranging from the early design and qualification of batteries to the analysis of field returns for safety and performance issues. During the qualification stage, he utilizes a variety of methods to assist clients such as quality assessments, risk assessments (FMEA, fault tree analysis), non-standard testing tailored to end-use, accelerated aging, and forced thermal runaway testing. Dr. Beers also conducts investigations related to potential product recalls associated with battery safety concerns and provides technical support to attorneys engaged in legal proceedings involving battery technology, lawsuits and arbitrations. For his work in this area, he utilizes a variety of in-house testing capabilities, including: X-ray CT scanning, cell teardowns, full cell cross sections, reference electrode testing, charge / discharge cycling, electrochemical impedance spectroscopy (EIS), imaging techniques (SEM, FIB), chemical analysis techniques (FTIR, EDS, GC-MS, and LC-MS), and mechanical and thermal testing. His work in this area builds upon previous experience in his graduate studies where he used X-ray scattering and electron imaging to characterize polymeric components in batteries, including solid polymer electrolytes, polymer separators, and polymer electrode binders.

In the field of polymer science, Dr. Beers consults on topics ranging from materials compatibility, small molecule migration and transport, adhesion, failure analysis, and polymers used in electrochemical and filtration applications. He has contributed to technology and product development, and the evaluation and mitigation of performance-based risk. Prior to joining Exponent, he conducted research focused on the design, synthesis, and characterization of model proton conducting semi-crystalline block copolymers for use in fuel cells. He determined how polymer crystallization affects the self-assembly, conductivity, and water uptake of these systems. In addition, Dr. Beers developed a method of surface modifying battery separators to make them hydrophilic, facilitating their use as water filtration membranes and porous ion-exchange resins.

Academic Credentials & Professional Honors

Ph.D., Chemical Engineering, University of California, Berkeley, 2012

B.S., Chemical Engineering, University of Colorado, Boulder, *cum laude*, 2007

Licenses and Certifications

Licensed Professional Chemical Engineer, California, #6695

Prior Experience

Graduate Student Research Assistant, Lawrence Berkeley National Laboratory, 2008-2012

Summer Intern, Oceanit, Summer 2007

Undergraduate Researcher, University of Colorado, 2006-2007

Summer Undergraduate Researcher, Hawaii Natural Energy Institute, Summer 2005

Publications

Beers KM, Wong DT, Jackson AJ, Wang X, Pople JA, Hexemer A, Balsara NP. Effect of crystallization on proton transport in model polymer electrolyte membranes. *Macromolecules* 2014; 47(13):4330-4336.

Chen X, Wong DT, Yakovlev S, Beers KM, Downing KH, Balsara NP. Effect of morphology of nanoscale hydrated channels on proton conductivity in block copolymer electrolyte membranes. *Nano Letters* 2014; 14(7):4058-4064.

Beers KM, Yakovlev S, Jackson AJ, Wang X, Hexemer A, Downing KH, Balsara NP. Absence of Schroeder's paradox in a nanostructured block copolymer. *Journal of Physical Chemistry B* 2014; 118(24):6785-6791.

Jackson A*, Beers KM*, Chen XC, Hexemer A, Pople JA, Kerr J B, Balsara NP. Design of a humidity controlled sample stage for simultaneous conductivity and synchrotron X-ray scattering measurements. *Review of Scientific Instruments* 2013; 84:075114.

*Authors contributed equally.

Wong DT, Wang C, Beers KM, Kortright JB, Balsara NP. Mesoporous block copolymer morphology studied by contrast-matched resonant soft X-ray scattering. *Macromolecules* 2012; 45(22):9188-9195.

Beers KM, Balsara NP. Design of cluster-free polymer electrolyte membranes and implications on proton conductivity. *ACS Macro Letters* 2012; 1(10):1155-1160.

Patel SN, Javier AE, Beers KM, Pople JA, Ho V, Segalman RA, Balsara NP. Morphology and thermodynamic properties of a copolymer with and electronically conducting block: poly(3-ethylhexylthiophene)-block-poly(ethylene oxide). *Nano Letters* 2012; 12(9):4901-4906.

Beers KM, Hallinan DT, Wang X, Pople JA, Balsara NP. Counterion condensation in Nafion. *Macromolecules* 2011; 44(22):8866-8870.

Wang X, Beers KM, Kerr JM, Balsara NP. Conductivity and water uptake in block copolymers containing protonated polystyrene sulfonate and its imidazolium salt. *Soft Matter* 2011; 7(9):4446-4452.

Balsara NP, Beers KM. Proton conduction in materials comprising conducting domains with widths less than 6 nm. *European Polymer Journal* 2011; 47(4):647-650.

Wang X, Yakovlev S, Beers KM, Park MJ, Mullin SA, Downing KH, Balsara NP. Origin of slow changes in ionic conductivity of model block copolymer electrolyte membranes in contact with humid air. *Macromolecules* 2010; 43(12):5306-5314.

Reports

Turn SQ, Keffer V, Beers KM. Physiochemical analysis of selected biomass materials in Hawaii. Report prepared for the State of Hawaii Department of Business, Economic Development and Tourism, 2005.

Conference Presentations and Published Abstracts

Licht R, Cohn A, Beers K. The Effects of Cycling Protocols on Internal Cell Structure. PlugVolt Battery Seminar 2019, Plymouth, MI, July 16, 2019.

Beers K, Licht R, Spray R, Burke C, Cohn A, Bogart T, Forman J, Rucker R, Godshaw J, Harding J, White K, Horn Q. Testing Tools and Methodologies for Lithium-ion Cell Qualification. 2019 IEEE Symposium on Product Safety and Compliance Engineering (ISPCE), San Jose, CA, May 2019.

Beers K, Spray R, White K, Horn Q, Bogart T, Forman J, Licht R. Fundamentals of Lithium-ion Technology: Cell Safety and Performance. 2018 Safety Summit San Diego (SSSD), San Diego, CA, October 2018.

Bogart T, Licht R, Beers K, Godshaw J, Rucker R, Forman J, White K. Understanding Degradation of Lithium-Ion Battery Performance. Advanced Automotive Battery Conference (AABC), San Diego, CA, 2018.

Beers K, White K, Spray R, Horn Q, Harding J. Safety of Lithium-ion Batteries, IEEE SCV Product Safety Engineering Society Meeting (PSES), Menlo Park, CA, 2017.

Beers K, Breitenkamp K, White K, McNulty J. The Do's and Don'ts of Wearable Device Design. 2017 SMTA Dallas Expo & Tech Forum, Dallas, TX, March 2017.

Beers K, White K, Spray R. Failure Modes and Risk Mitigation Strategies for Batteries in Wearable Devices. 2016 Medical Electronics Symposium, Portland, OR, September 2016

Chen C, Wong DT, Beers KM, Balsara NP. Morphology and proton transport in sulfonated block copolymer and mesoporous polymer electrolyte membranes. National Meeting of the American Physical Society, Baltimore, MD, March 2013.

Beers KM, Jackson A, Balsara NP. Characterization of the disorder-order transition in hydrated block copolymers using humidity controlled SAXS. Synchrotron Radiation in Polymer Science Conference, San Francisco, CA, March 2012.

Beers KM, Jackson A, Balsara NP. Disorder-order transitions in humidified block copolymer electrolytes studied by in situ SAXS. National Meeting of the American Physical Society, Boston, MA, March 2012.

Wong DT, Beers KM, Wang C, Kortright J, Balsara, NP. Characterizing mesoporous block copolymers by resonant soft X-ray scattering. National Meeting of the American Physical Society, Boston, MA, March 2012.

Beers KM, Wang X, Balsara NP. Characterization of a model polyelectrolyte membrane using a semi-

crystalline block copolymer. National Meeting of the American Physical Society, Dallas, TX, March 2011.

Wang X, Balsara NP, Beers KM, Park MJ. Conductivity and water content in asymmetrical sulfonated block copolymers. National Meeting of the American Physical Society, Portland, OR, March 2010.