

Exponent®
Engineering & Scientific Consulting

Kyle Diederichsen, Ph.D., P.E.

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Professional Profile

Kyle Diederichsen, Ph.D., P.E., is a managing engineer in Exponent's Polymers & Chemistry practice specializing in data-driven investigations of materials failures, plastic plumbing systems, and industrial processes. Using his experience in chemical engineering, polymer science, electrochemistry, and materials chemistry, Dr. Diederichsen advises law firms, manufacturers, and industrial clients on materials performance, product failures, industrial processing questions, and disputes ranging from complex construction defect litigation to product liability and intellectual property evaluation.

Consulting as a Chemical Engineer

Dr. Diederichsen applies his foundation in fundamental chemical engineering principles from his B.S. at the University of Colorado, his Ph.D. at UC Berkeley, and postdoctoral work at MIT— including mass transport, reaction kinetics, separations, and thermodynamics — to diagnose why complex materials systems underperform or fail. He supports clients across building materials, construction, automotive, oil and gas, and consumer electronics industries, translating rigorous engineering science into defensible, practical conclusions. His consulting spans both reactive litigation support and proactive materials design, helping clients understand root causes before problems escalate into costly disputes or recalls.

Plastic Degradation & Failures

Dr. Diederichsen has led and supported investigations into plastic plumbing failures, including cross-linked polyethylene (PEX) tubing degradation, fitting failures, and chemical compatibility issues in residential and commercial water distribution systems. He evaluates degradation mechanisms such as oxidative embrittlement, stress cracking, chlorine-induced degradation, and premature aging — common types of failures that drive large-scale construction litigation and insurance claims. He is experienced with industry standards such as ASTM F876 and F2023 and multiple characterization methods including thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), oxidation induction time (OIT), Fourier-transform infrared spectroscopy (FTIR), and chromatography to identify polymer degradation modes.

Data-Driven Investigation

Dr. Diederichsen integrates data science methods into materials failure and engineering investigations, using Python-based analysis pipelines to automate data processing, identify patterns across large datasets, and accelerate the path from raw evidence to defensible conclusions. He has built custom test systems that combine sensor data, electrochemical measurements, and materials characterization outputs into unified analytical frameworks. This capability is particularly valuable in complex, multi-party litigation where large volumes of field data, document productions, laboratory results, and inspection

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records must be synthesized efficiently and transparently. He holds a certificate in data science from the University of Washington (2024).

Materials Chemistry Analysis

Dr. Diederichsen's expertise in materials chemistry encompasses polymer synthesis and characterization, ion transport in polymeric systems, chemical contamination analysis, and the physical and thermal behavior of engineering materials. He is experienced with a broad suite of analytical techniques — including nuclear magnetic resonance (NMR), scanning electron microscopy (SEM), electrochemical impedance spectroscopy (EIS), and dynamic scanning calorimetry (DSC) — to probe the chemical, structural, and thermal properties of polymers, coatings, membranes, and ion-containing materials. This depth supports both litigation-driven root-cause analysis and proactive intellectual property evaluation for manufacturers and developers.

Electrochemical Processes

Dr. Diederichsen brings specialized expertise in electrochemical systems, including battery electrolyte design, flow electrochemistry, and electrochemically mediated separations. His doctoral research at UC Berkeley focused on high transference number polymer-based electrolytes for lithium-ion batteries, and his postdoctoral work at MIT addressed electrochemical carbon capture using hollow fiber membrane contactors and continuous-flow systems. In consulting, this background informs his analysis of battery-related failures, industrial electrochemical processes, and other processes where complex interfacial chemistry is central to understanding the problem at hand.

Academic Credentials & Professional Honors

Ph.D., Chemical Engineering, University of California, Berkeley, 2019

B.S., Chemical Engineering, University of Colorado, Boulder, 2014

Intelligence Community Postdoctoral Fellowship at MIT, 2020 – 2022

Certificate in Data Science, University of Washington, 2024

MIT Infinite Mile Award, 2022

Marilyn and Howard L. Anseth Outstanding Undergraduate Research Award, 2014

Licenses and Certifications

Professional Engineer Chemical, California, #7176

Professional Engineer, Hawaii, #PE-22227

Professional Engineer Chemical, Texas, #161455

Professional Engineer Chemical, Washington, #26004505

Prior Experience

Postdoctoral Fellow, Massachusetts Institute of Technology (MIT), 2019-2022

Summer Internship, Bend Research (Oregon), 2013

Undergraduate Research Fellowship, National Institute of Standards and Technology, 2012-2013

Professional Affiliations

American Chemical Society (ACS)

Society of Polymer Engineering (SPE)

Electrochemical Society (ECS)

American Institute of Chemical Engineers (AIChE)

Publications

Massen-Hane, M.M.; Diederichsen, K. M.; Hatton, T. A. Engineering redox-active electrochemically mediated carbon dioxide capture systems. Nature Chemical Engineering. 2024, 11, 35-44

Diederichsen, K. M.; DeWitt, S. J.; Hatton, T. A. Electrochemically Facilitated Transport of CO2 between Gas Diffusion Electrodes in Flat and Hollow Fiber Geometries. ACS ES&T Engineering. 2023, 3, 7, 1001–1012

Diederichsen, K. M.; Hatton, T. A. Nondimensional Analysis of a Hollow Fiber Membrane Contactor for Direct Air Capture. Ind. Eng. Chem. Res. 2022, 61, 11964–11976.

Diederichsen, K. M.*; Sharifian, R.*; Kang, J. S.; Liu, Y.; Kim, S.; Gallant, B. M.; Vermaas, D.; Hatton, T. A. Electrochemical Methods for Carbon Dioxide Separations. Nat. Rev. Methods Prim. 2022, 2, 68.

Simeon, F.; Stern, M. C.; Diederichsen, K. M.; Liu, Y.; Herzog, H. J.; Hatton, T. A. Electrochemical and Molecular Assessment of Quinones as CO2-Binding Redox Molecules for Carbon Capture. J. Phys. Chem. C 2022, 126, 1389-1399.

Diederichsen, K. M.*; Liu, Y.*; Ozbek, N.; Seo, Hyowon; Hatton, T. A. Towards Solvent-Free Continuous-Flow Electrochemically Mediated Carbon Capture with High Concentration Liquid Quinone Chemistry. Joule 2022, 6, 221-239. *Equal contribution.

Rahimi, M.; Diederichsen, K. M.; Ozbek, N.; Wang, M.; Choi, W.; Hatton, T. A. An Electrochemically Mediated Amine Regeneration Process with a Mixed Absorbent for Postcombustion CO2 Capture. Environ. Sci. Technol. 2020, 54, 8999–9007.

Liu, Y.; Ye, H.; Diederichsen, K. M.; Van Voorhis, T.; Hatton, T. A. Electrochemically Mediated Carbon Dioxide Separation with Quinone Chemistry in Salt-Concentrated Aqueous Media. Nat. Commun. 2020, 11, 2278.

Kim, H. W.; Bukas, V. J.; Park, H.; Park, S. J.; Diederichsen, K. M.; Lim, J.; Cho, Y. H.; Yoon, H. W.; Kim, W.; Han, H.; et al. Mechanisms of Two-Electron and Four-Electron Electrochemical Oxygen Reduction Reactions at Nitrogen-Doped Reduced Graphene Oxide. ACS Catal. 2020, 10, 852–863.

Diederichsen, K. M.; Terrell, R. C.; McCloskey, B. D. Counterion Transport and Transference Number in Aqueous and Nonaqueous Short-Chain Polyelectrolyte Solutions. J. Phys. Chem. B 2019, 123, 10858–10867.

Diederichsen, K. M.; McCloskey, B. D. Electrolyte Additives to Enable Nonaqueous Polyelectrolyte Solutions for Lithium Ion Batteries. Mol. Syst. Des. Eng. 2020, 5 (1), 91–96.

Fong, K. D.; Self, J.; Diederichsen, K. M.; Wood, B. M.; McCloskey, B. D.; Persson, K. A. Ion Transport and the True Transference Number in Nonaqueous Polyelectrolyte Solutions for Lithium Ion Batteries. ACS Cent. Sci. 2019, 5, 1250–1260.

Hsu, C. H.; Ma, C.; Bui, N.; Song, Z.; Wilson, A. D.; Kostecki, R.; Diederichsen, K. M.; McCloskey, B. D.; Urban, J. J. Enhanced Forward Osmosis Desalination with a Hybrid Ionic Liquid/Hydrogel Thermo-responsive Draw Agent System. ACS Omega 2019, 4, 4296-4303.

Diederichsen, K. M.; Fong, K. D.; Terrell, R. C.; Persson, K. A.; McCloskey, B. D. Investigation of Solvent Type and Salt Addition in High Transference Number Nonaqueous Polyelectrolyte Solutions for Lithium-Ion Batteries. Macromolecules 2018, 51, 8761-8771.

Liyana-Arachchi, T. P.; Haskins, J. B.; Burke, C. M.; Diederichsen, K. M.; McCloskey, B. D.; Lawson, J. W. Polarizable Molecular Dynamics and Experiments of 1,2-Dimethoxyethane Electrolytes with Lithium and Sodium Salts: Structure and Transport Properties. J. Phys. Chem. B 2018, 122, 8548–8559.

Kim, H. W.; Yoon, J. H.; Diederichsen, K. M.; Shin, J. E.; Yoo, B. M.; McCloskey, B. D.; Park, H. B. Exceptionally Reinforced Polymer Nanocomposites via Incorporated Surface Porosity on Graphene Oxide Sheets. Macromol. Mater. Eng. 2017, 302, 1700039.

Diederichsen, K. M.; McShane, E. J.; McCloskey, B. D. Promising Routes to a High Li + Transference Number Electrolyte for Lithium Ion Batteries. ACS Energy Lett. 2017, 2, 2563–2575.

Diederichsen, K. M.; Buss, H. G.; McCloskey, B. D. The Compensation Effect in the Vogel–Tammann–Fulcher (VTF) Equation for Polymer-Based Electrolytes. Macromolecules 2017, 50, 3831–3840.

Diederichsen, K. M.; Brow, R. R.; Stoykovich, M. P. Percolating Transport and the Conductive Scaling Relationship in Lamellar Block Copolymers under Confinement. ACS Nano 2015, 9, 2465–2476.

Miller, D. L.; Keller, M. W.; Shaw, J. M.; Rice, K. P.; Keller, R. R.; Diederichsen, K. M. Giant Secondary Grain Growth in Cu Films on Sapphire. AIP Adv. 2013, 3, 082105.

Presentations

“Managing Risks of Sustainability and Circularity Claims.” With Hilda Buss and Andrew Worthen. PSX. 2025. Houston, TX.

“Continuous systems driven by electrochemistry to capture CO2 from dilute streams.” Intelligence Community Annual Research Symposium, 2022. Virtual

“Redox-Active Liquid Sorbent for Electrochemically Mediated Carbon Capture.” ACS Annual Meeting, 2022. Virtual.

“Understanding Multiscale Transport Challenges in Electrochemically Mediated Carbon Capture.” Intelligence Community Annual Research Symposium, 2021. Virtual.

“Influence of Backbone Solvation on Polyelectrolyte Solution Transport Properties.” AIChE. November 11, 2019. Orlando, FL.

“High Transference Number Polymer – Based Electrolytes.” Departmental Colloquium. December 5, 2018. Berkeley, CA.

“Investigation of Solvent Composition and Salt Addition in High Transference Number Nonaqueous Polyelectrolyte Solutions.” Invited Talk. Excellence in Graduate Polymer Research Section at AIChE. October 30, 2018. Pittsburgh, PA.

“Investigation of Solvent Type and Salt Addition in High Transference Number Nonaqueous Polyelectrolyte Solutions.” Poster. Polymer Physics Gordon Research Conference. July 2018. Mt. Holyoke, MA.

“Breaking the Compensation Effect within the Vogel-Tammann-Fulcher Equation for Polymer-Based Electrolytes.” AIChE. November 1, 2017. Minneapolis, MN

“Charged Polysulfone Based Polymer Electrolytes for Lithium-Ion Batteries.” Poster. AIChE. November 14, 2016. San Francisco, CA.

Peer Reviews

J. Phys. Chem. Lett.

Batteries

Energies

Soft Materials

ChemEngineering

Applied Sciences

Coatings

Membranes