



Exponent®

Engineering & Scientific Consulting

Charles Lhermitte, Ph.D.

Senior Scientist | Polymer Science and Materials Chemistry

Natick

+1-508-903-4640 tel | clhermitte@exponent.com

Professional Profile

Dr. Lhermitte is an electrochemist and materials scientist with 12 years' experience in metal oxide material synthesis and physical electrochemistry. His vast experience with electrochemical systems spans semiconducting thin films, hetero and homogeneous electrocatalysts, photoelectrodes and photoelectrochemical cells, ion intercalation materials, and molten salt electrochemical methods. Within Exponent, he employs his expertise in chemistry and materials science to solve problems related to electrochemical energy storage, with a special emphasis on using battery failure analysis as a driver for improving product safety, reliability and performance.

Prior to joining Exponent, Dr. Lhermitte was a scientist at Los Alamos National Laboratory, where he carried out research directed towards the design and synthesis of high-performance ceramic materials. In addition to this, he developed new methods to effect isotope separations. Furthermore, he was also the lead electrochemist for the molten salt chemistry team. In this role he carried out research in several technical spaces spanning actinide chemical behavior, materials corrosion, and metal electrodeposition from chloride and fluoride molten salts at high temperatures. Key developments in these areas were the design and construction of a high-resolution electrochemical apparatus for molten salt electrochemical experiments, the measurement of the standard reduction potentials of different metals, and the development of electroplating processes to produce thin films of refractory metals from molten salts.

In addition to his experience at Los Alamos, Dr. Lhermitte also worked as a Scientific Collaborator in the Ecole Polytech Federale de Lausanne's LIMNO laboratory. There he focused on the design and synthesis of novel semiconducting oxide thin film photoelectrodes for applications in waste organic material upcycling and water splitting photoelectrochemical cells. Key developments in these areas were the design and construction of a rotating ring disk photoelectrode to detect photo generated products in situ, in addition to the direct oxidation of waste organic materials to useful precursors for polymer synthesis using tungsten oxide photoelectrodes.

Academic Credentials & Professional Honors

Ph.D., Chemistry, University of Michigan, Ann Arbor, 2017

B.S., Chemistry, University of Miami, 2011

Prior Experience

Scientist, Los Alamos National Laboratory, 2022-2023

Post-doc, Los Alamos National Laboratory, 2019-2022

Scientific Collaborator École Polytechnique Fédérale de Lausanne, 2017-2019

Professional Affiliations

2023-present, Los Alamos National Lab, visiting scientist

2016-present, Electrochemical Society, member

Publications

Polo, A., Dozzi, M.V., Grigioni, I., Lhermitte, C., Plainpan, N., Moretti, L., Cerullo, G. Sivula, K., Selli, E. Multiple Effects Induced by Mo⁶⁺ Doping in BiVO₄ Photoanodes. *Solar RRL*. 2022, 6, 2200349.

Polo, A., Boudoire, F., Lhermitte, C., Liu, Y., Guijarro, N., Dozzi, M. V., Selli, E., Sivula, K. Key factors boosting the performance of planar ZnFe₂O₄ photoanodes for solar water oxidation. *J. Mater. Chem. A*. 2021, 9, 27736.

Parker, S. S., Long, A., Lhermitte, C., Vogel, S., Monreal, M., Jackson, J. M., Thermophysical Properties of Liquid Chlorides from 600 – 1600 K: Melt Point, Enthalpy of Fusion, and Volumetric Expansion. *J. Mol. Liq.*, 2021, 118147.

Boudoire, F., Yongpeng, L., Le Formal, F., Guijarro, N., Lhermitte, C., Sivula, K. Spray synthesis of CuFeO₂ photocathodes and in-operando assessment of charge carrier recombination. *J. Phys. Chem. C*, 2021, 125, 20, 10883.

Lhermitte, C. R., Parker, S. S., Jackson, J. M., Monreal, M. J., Mg^{2+/0} as a reliable reference electrode for molten chloride salts. *J. Electrochem. Soc.*, 2021, 168, 066501.

Lhermitte, C. R., Plainpan, N., Canjura, P., Boudoire, F. A., Sivula, K., Direct Photoelectrochemical Oxidation of Hydroxymethylfurfural on Tungsten Trioxide Photoanodes, *RSC Adv.*, 2021, 11, 198-202.

Lhermitte, C. R., Polo, A., Yao, L., Boudoire, F. A., Guijarro, N., Sivula, K., Generalized Synthesis to Produce Transparent Thin films of Ternary Metal Oxide Photoelectrodes, *ChemSusChem*, 2020, 13, 14, 3645-3653.

Polo, A., Lhermitte, C. R., Dozzi, M. V., Selli, E., Sivula, K. Hydrogenation of ZnFe₂O₄ Flat Films: Effects of the Pre-Annealing Temperature on the Photoanodes Efficiency for Water Oxidation. *Surfaces*. 2020, 3, 1, 93-104.

Wells, R. A., Johnson, H., Lhermitte, C. R., Kinge, S., Sivula, K. Roll-to-Roll Deposition of Semiconducting 2D Nanoflake Films of Transition Metal Dichalcogenides for Optoelectronic Applications. *ACS Appl. Nano Mater.* 2019, 2, 12, 7705-7712.

Lhermitte, C. R.; Sivula, K., Alternative Oxidation Reactions for Solar-driven Fuel Production. *ACS Catal.* 2019, 9, 3, 2007-2017.

Rahmanudin, A.; Yao, L.; Sekar, A.; Cho, H.-H.; Liu, Y.; Lhermitte, C. R.; Sivula, K., Fully-conjugated donor-acceptor block-copolymers for organic photovoltaics via Heck-Mizoroki coupling, *ACS Macro Lett.* 2019, 8, 2, 134-139.

Breuhaus-Alvarez, A.; DiMeglio, J. L.; Cooper, J.; Lhermitte, C. R.; Bartlett, B. M., Kinetics and Faradaic Efficiency of Oxygen Evolution on Reduced HxWO₃ Photoelectrodes, *J. Phys. Chem. C* 2019, 123, 2, 1142-1150

Lhermitte, C. R., Bartlett, B. M., Advancing the Chemistry of CuWO₄ for Photoelectrochemical Water Oxidation, *Acc. Chem. Res.*, 2016, 49, 6, 1121

Lhermitte, C. R., Verwer, J. G., Bartlett, B. M., Improving the stability and selectivity for the oxygen-evolution reaction on semiconducting WO₃ photoelectrodes with a solid-state FeOOH catalyst, *J. Mater. Chem. A*, 2016, 4, 2960-2968

X. Cai, S. Majumdar, S., Fortman, G. C., Cazin, C. S. J., Slawin, A. M. Z., Lhermitte, C., Prabhakar, R., Germain, M. E., Palluccio, T., Nolan, S. P., Rybak-Akimova, E. V., Temprado, M., Captain, B., and Hoff, C. D. Oxygen Binding to [Pd(L)(L')] (L= NHC, L' = NHC or PR₃, NHC = N-Heterocyclic Carbene). Synthesis and Structure of a Paramagnetic trans-[Pd(NHC)(2)(η(1)-O₂)(2)] Complex. *J. Am. Chem. Soc.* 2011, 133, 1290-1293.

Presentations

Lhermitte, C. R. Investigating the Electrochemical Behavior of Uranium in Chloride Melts. Invited talk. University of Michigan. Ann Arbor, MI. 2023.

Lhermitte, C. R. Developing Robust Reference Electrode Chemistry for Electrochemical Corrosion Experiments in Actinide Bearing Molten Salts. Oral presentation, Actinide Separations Conference, Organized by PNNL, virtual attendance. 2021.

Lhermitte, C. R. Developing Robust Reference Electrode Chemistry for Electrochemical Corrosion Experiments in Actinide Bearing Molten Salts. Oral presentation, Corrosion for Mission Science Workshop, Organized by LANL, virtual attendance. 2021.

Lhermitte, C. R. Solar Powered Biomass Valorization and H₂ Fuel Production Using Metal Oxides. Invited talk. University of Miami. Miami, FL. 2019.

Lhermitte, C. R. Synthesis of Thin Films of Metal Oxides and Their Application as Photoanodes for Solar Energy Storage. Invited talk. Sandia National Laboratory. Albuquerque, NM. 2019.

Lhermitte, C. R. Radical Redox Mediator Free Photoelectrochemical Biomass Valorization. Oral presentation, The electrochemical society 236th meeting, Atlanta, GA 2019.

Lhermitte, C. R. Accelerating the Rate of Solar Water Splitting on WO₃ by Depositing a Stable FeOOH Catalyst. Oral presentation, University of Michigan Karle Symposium. Ann Arbor, MI. 2016.

Lhermitte, C. R. Improving the stability and selectivity for OER of WO₃ photoanodes with an FeOOH oxygen evolution catalyst. Oral presentation. American Chemical Society Central Regional Meeting. Covington, KY. 2016.

Peer Reviews

Journal of the electrochemical society