



Exponent[®]
Engineering & Scientific Consulting

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Professional Profile

Dr. Luu specializes in electrochemistry and materials characterization, focusing on lithium-ion battery materials. He has diverse experience spanning the development of next-generation battery chemistries, microscopic and spectroscopic materials analysis, and understanding degradation in electrochemical systems and devices.

At Exponent, Dr. Luu is actively involved in battery qualification and failure analysis, drawing from his experience in techniques in electrochemical testing (charge/discharge cycling, EIS, voltammetry), spectroscopy (XPS, EDS, Raman, FTIR), microscopy (SEM, TEM), thermal analysis (TGA, DSC), and X-ray characterization (X-ray CT, XRD). Dr. Luu also leverages his prior experience at both small and large-scale battery companies to address problems across battery cells and packs.

Prior to joining Exponent, Dr. Luu obtained his Ph.D. from Northwestern University, where he developed advanced lithium-ion battery cathode, anode, electrolyte, and separator materials. His research focused on the integration of nanomaterials into energy storage devices possessing high rate capabilities, long lifetimes, and improved thermal safety. He also has practical knowledge of cell and pack manufacturing, cathode materials synthesis, and solution-phase processing techniques.

Academic Credentials & Professional Honors

Ph.D., Materials Science and Engineering, Northwestern University, 2023

B.S., Materials Science and Engineering, Northwestern University, 2016

Prior Experience

Materials Engineering Intern, Tesla, 2022

Engineering Intern, NanoGraf Corporation, 2017

Patents

WO Patent App No 2022/076280: Composites with surface refining and conformal graphene coating, electrodes, and fabricating methods of same, April 2022 (Hersam MC, Lim JM, Luu NS).

US Patent App No. 17/713,373: Composite material with conformal graphene coating, fabricating methods and applications of same (Hersam MC, Luu NS, Lim JM).

Publications

Luu NS, Meza PE, Tayamen AM, Kahvecioglu O, Rangnekar SV, Hui J, Downing JR, Hersam MC. Enabling Ambient Stability of LiNiO₂ Lithium-Ion Battery Cathode Materials via Graphene–Cellulose Composite Coatings. *Chemistry of Materials* 2023; 35, 13, 5150–5159

Torres-Castanedo CG, Evmenenko G, Luu NS, Das PM, Hyun WJ, Park KY, Dravid VP, Hersam MC, Bedzyk MJ. Enhanced LiMn₂O₄ Thin-Film Electrode Stability in Ionic Liquid Electrolyte: A Pathway to Suppress Mn Dissolution. *ACS Applied Materials and Interfaces* 2023; 15, 29, 35664–35673.

Luu NS,* Park KY,* Hersam MC. Chemomechanical Degradation in High-Energy Lithium-ion Battery Cathode Materials. *Accounts of Materials Research* 2022; 3, 5, 511–524.

Park KY, Zhu Y, Torres-Castanedo CG, Jung HJ, Luu NS, Kahvecioglu O, Yoo Y, Seo JWT, Downing JR, Lim HD, Bedzyk MJ, Wolverton C, Hersam MC. Elucidating and Mitigating High-Voltage Degradation Cascades in Cobalt-Free LiNiO₂ Lithium-Ion Battery Cathodes. *Advanced Materials* 2022; 34, 3, 2106402.

Luu NS, Lim JM, Torres-Castanedo CG, Park KY, Moazzen E, He K, Meza PE, Li W, Downing JR, Hu X, Dravid VP, Barnett SA, Bedzyk MJ, Hersam MC. Elucidating and Mitigating High-Voltage Chemomechanical Degradation of Nickel-Rich Lithium-Ion Battery Cathodes via Conformal Graphene Coating. *ACS Applied Energy Materials* 2021; 4, 10, 11069–11079.

Hyun WJ, Thomas CM, Luu NS, Hersam MC. Heterostructured Ionogel Electrolytes for High-Performance Solid-State Lithium-Ion Batteries. *Advanced Materials* 2021; 33, 2007684.

Lim JM,* Luu NS,* Park KY, Tan MTZ, Kim S, Downing JR, He K, Dravid VP, Hersam MC. Enhancing Nanostructured Nickel-Rich Lithium-Ion Battery Cathodes via Surface Stabilization. *Journal of Vacuum Science & Technology A* 2020; A 38, 063210.

Park KY, Lim JM, Luu NS, Downing JR, Wallace SG, Chaney LE, Yoo H, Hyun WJ, Kim HU, Hersam MC. Concurrently Approaching Volumetric and Specific Capacity Limits of Lithium Battery Cathodes via Conformal Pickering Emulsion Graphene Coatings. *Advanced Energy Materials* 2020; 10, 25, 2001216.

Moraes ACM, Hyun WJ, Luu NS, Lim JM, Park KY, Hersam MC. Phase-Inversion Polymer Composite Separators Based on Hexagonal Boron Nitride Nanosheets for High-Temperature Lithium-Ion Batteries. *ACS Applied Materials and Interfaces* 2020; 12, 7, 8107–8114

Lim JM, Kim S, Luu NS, Downing JR, Tan MTZ, Park KY, Hechter JC, He K, Dravid VP, Hersam MC. High Volumetric Energy and Power Density Li₂TiSiO₅ Battery Anodes via Graphene Functionalization. *Matter* 2020; 3, 2, 522-533.

Chen KS, Balla I, Luu NS, Hersam MC. Emerging Opportunities for Two-Dimensional Materials in Lithium-Ion Batteries. *ACS Energy Letters* 2017; 2, 9, 2026-2034.

Chen KS, Xu R, Luu NS, Secor EB, Li Q, Kim S, Balla I, Guiney L, Seo JW, Liu W, Wu J, Dravid VP, Wolverton C, Lu J, Amine K, Hersam MC. Comprehensive enhancement of nanostructured lithium-ion battery cathode materials via conformal graphene dispersion. *Nano Letters* 2017; 17, 4, 2539-2546.

Wu YL, Horwitz N, Chen KS, Gomez-Gualdron D, Luu NS, Ma L, Wang T, Hersam MC, Hupp JT, Farha O, Snurr, R, Wasielewski M. G-Quadruplex Organic Frameworks. *Nature Chemistry* 2016; 9, 466–472.

*equal contribution

Presentations

Luu NS, Lim JM, Torres-Castanedo CG, Park KY, Moazzen E, He K, Meza PE, Li W, Downing JR, Hu X, Dravid VP, Barnett SA, Bedzyk MJ, Hersam MC. Elucidating and Mitigating High-Voltage Chemomechanical Degradation of Nickel-Rich Lithium-Ion Battery Cathodes via Conformal Graphene Coating. 241st Meeting of the Electrochemical Society, Vancouver, BC, 2021.

Luu NS, Hyun WJ, Villa C, Torres-Castanedo CG, Lim JM, Hu X, Bedzyk MJ, Dravid VP, Hersam MC. Electrochemistry of the Hexagonal Boron Nitride-Ionic Liquid Gel Electrolyte Interface. Energy Frontier Research Center Principal Investigators' Meeting, Department of Energy, Washington DC, 2019.

Project Experience

Managed and conducted failure analysis of lithium-ion cells and devices ranging from single unit failures to large recall investigations.

Performed cell quality evaluations encompassing cycle testing, cell construction analysis, and materials analysis.

Conducted prior art reviews of battery technologies and product deconstruction to provide technical expertise in intellectual property disputes.

Performed failure analysis to identify mechanical and thermal failure modes in metallic cans and cathode material manufacturing equipment used for production of cylindrical lithium-ion batteries.

Led materials development projects to enhance rate capabilities, lifetimes, cycling efficiencies, and ambient stabilities of lithium-ion battery active materials.