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Engineering & Scientific Consulting

Michael Citrin, Ph.D.

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Professional Profile

Dr. Citrin is a materials engineer whose area of expertise includes electrochemical energy storage, particularly lithium metal and lithium-ion batteries, nanomechanics, and additive manufacturing. He has deep knowledge of electrochemical, mechanical, and microstructural characterization of materials with a focus on nano- and micro- scale materials. His strong materials science background and understanding of structure-process-property relationships in materials allow him to determine failure mechanisms in materials and devices.

He has extensive expertise on techniques to characterize electrochemical and mechanical properties of materials used in solid-state batteries, namely by combining scanning electron microscopy (SEM), electrochemical cycling, and nanomechanical compression. Dr. Citrin also has substantial experience in microstructural characterization of nano-scale materials using focused ion beam (FIB) milling, transmission electron microscopy (TEM), and cryogenic electron microscopy (cryo-EM). Additionally, he has characterized traditional and additively manufactured lithium ion battery electrodes using x-ray diffraction (XRD), cyclic voltammetry (CV), and traditional battery cycling in addition to SEM/FIB analysis.

Prior to joining Exponent, Dr. Citrin worked as a Graduate Research Assistant at the California Institute of Technology (Caltech), where he received a Ph.D. and M.S. in Materials Science. His research focused on the microstructure and nanomechanical properties of lithium electrodeposited in solid-state batteries and additively manufactured 3D lithium-ion battery electrodes. Before attending graduate school, he investigated the magnetic properties of stainless steel and worked on reducing electrical contact resistance for strained silicon nanowires used as thermoelectric materials, both at the University of Pennsylvania.

Academic Credentials & Professional Honors

Ph.D., Materials Science, California Institute of Technology (Caltech), 2020

M.S., Materials Science, California Institute of Technology (Caltech), 2016

B.S.E., Materials Science and Engineering, University of Pennsylvania, 2014

R. M. Brick Award, 2014

Professional Affiliations

Materials Research Society (MRS)

Tau Beta Pi Honor Society

Patents

US Patent Application 16/577,253: 3D Printing of Metal Containing Structures, September 2019 (Yee DW, Greer JR, Lifson ML).

US Patent Application 16/151,186: Three-Dimensional Architected Pyrolyzed Electrodes for Use in Secondary Batteries and Methods of Making Three-Dimensional Architected Electrodes, October 2018 (Greer JR, Vyatskikh A, Thorne JS, Kudo A, Narita K, X Zhang).

Publications

Citrin MA, Yang H, Nieh S, Berry J, Gao W, Pan X, Srolovitz DJ, and Greer JR. From ion to atom to dendrite: Formation and nanomechanical behavior of electrodeposited lithium. MRS Bulletin Impact, 1-14, 2020.

Presentations

Citrin MA, Yang H, Nieh S, Berry J, Malyutin A, Srolovitz DJ, and Greer JR. Mechanical Properties and Nucleation of Nano-sized Li Electrodeposited in a Solid-State Battery. Oral presentation, Nanomaterials for Applications in Energy Technology Gordon Research Seminar, Ventura, CA, 2019.

Citrin MA, Yang H, Gao W, Nieh S, Pan X, Berry J, Srolovitz DJ, and Greer JR. Mechanical Properties and Nucleation of Nano-sized Li Electrodeposited in a Solid-State Battery. Oral presentation, Materials Research Society Fall Meeting, Boston, MA, 2018.

Citrin MA and Greer JR. Mechanical Behavior of Nano-sized Electrodeposited Lithium. Oral presentation, ARPA-E IONICS Meeting at the Energy Innovation Summit, Washington, DC, 2018.

Citrin MA, Xu C, Yang H, and Greer JR. Mechanical Properties of Single Crystalline and Electrodeposited Lithium at Small Scales. Oral presentation, Materials Research Society Fall Meeting, Boston, MA, 2017.