

Erick Espinosa-Villatoro, Ph.D.

Materials Scientist | Battery R&D | Operando & Synchrotron Diagnostics

SLAC National Accelerator Laboratory

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Summary

Ph.D.-level Materials Scientist with 9+ years of experience in synchrotron-based diagnostics, electrochemistry, and advanced battery materials. Expertise in Ni-rich cathodes, Li-metal and Si anodes, and operando X-ray techniques (XAS, TXM, XRD). Proven track record of generating mechanistic insights into degradation pathways and collaborating across national labs and academia. Skilled in Python-based data analysis and mentoring early-career researchers.

Technical Skills

- **Synchrotron & X-ray Methods:** μ -XRF, μ -XANES, EXAFS, TXM, XRD (operando & ex situ)
- **Electrochemistry:** CV, EIS (DRT), galvanostatic cycling, rate/formation studies
- **Materials Characterization:** SEM, XPS, AFM, Cryo-EM, LALI-TOF-MS (EXUM Massbox)
- **Battery Systems:** Li-metal, Li-ion, Ni-rich cathodes, Si anodes, Na-ion; coin, pouch, Swagelok cells
- **Programming:** Python (NumPy, SciPy, Matplotlib, lmfit)

Research Experience

Postdoctoral Scholar

2022 – Present

Stanford Synchrotron Radiation Lightsource (SSRL), SLAC National Accelerator Laboratory

- Led operando and ex-situ synchrotron studies (XAS, TXM, XRD) to identify degradation pathways in Ni-rich LiNiO₂ cathodes across multiple chemistries and cycling conditions.
- Established relationships between dopant chemistry (Co, Mn, Al) and structural stability, supporting a multimodal study submitted to *Journal of Materials Chemistry A*.
- Designed and executed multimodal experiments integrating electrochemistry, interfacial chemistry, and structural evolution to explain cathode degradation mechanisms.
- Mentored 2 undergraduate interns and supervised a Ph.D. student on Si-anode degradation, contributing to their academic progression.
- Collaborated with UT Austin, INL, UCLA, and APS on DOE-funded projects focused on fast charging, Li-metal stability, and advanced diagnostics.

Battery Degradation Mechanisms (Selected Projects)

2023 – Present

- Integrated μ -XRF, μ -XANES, and LALI-TOF-MS into mechanistic models to quantify transition-metal crossover and SEI growth in Li||high-Ni systems.
- Directed high-resolution chemical mapping workflows, enabling 3D visualization of elemental distributions in battery electrodes. Surface of Li-metal anodes study submitted to *Joule Journal* in collaboration with INL.
- Developed Python-based spectral analysis tools to improve interpretation of Massbox data and heterogeneity tracking.

Postdoctoral Scientist

2021 – 2022

Instituto de Investigaciones en Materiales, UNAM

- Synthesized NaMO₂ (M = Fe, Mn) ceramics for CO₂ capture and battery cathode applications.
- **Demonstrated** up to 9.5% CO₂ capture at 800°C and 100% CO conversion at 450°C via optimized Na manganate systems.
- Identified reaction mechanisms (Avrami-Erofeev, Mars-van Krevelen) governing adsorption and catalytic performance.

Doctoral Researcher

2017 – 2021

Benemérita Universidad Autónoma de Puebla (BUAP) & SSRL, SLAC

- Developed Na-preconditioning strategies for Si anodes, improving SEI stability and cycling performance in Li-ion batteries.
- Applied operando XRD, TXM, and STXM-ptychography to characterize structural evolution and phase transformations.
- Produced **first author** work using 3D relaxation-time analysis to track lithiation processes and degradation mechanisms.

Education

Ph.D. in Materials Science

2017 – 2021

Benemérita Universidad Autónoma de Puebla, Mexico

M.Sc. in Materials Science

2015 – 2016

Benemérita Universidad Autónoma de Puebla, Mexico

B.E. in Energy Engineering

2011 – 2014

Universidad Politécnica de Chiapas, Mexico

Additional Information

- Languages: English (Fluent), Spanish (Native)