Shuxuan Liao

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EDUCATION

Qingdao University **Sep 2022 – Jun 2025**

Materials Engineering

- **GPA:** 3.83/4.0
- **Core Courses:** Material structures and properties, Material synthesis and preparation, Modern analysis technique for materials, New energy materials and devices

Nanjing Tech University **Sep 2017 – Jun 2021**

Optoelectronic Information Science and Engineering

- **GPA:** 3.57/4.0
- **Core Courses:** Electromagnetism, Analog electronics, Digital fundamentals, Electrodynamics, Quantum mechanics, Solid state physics, Optoelectronic technology

PUBLICATIONS

[1] **S. Liao**, *et al*. From spent lithium-ion batteries to high-performance supercapacitors: enabling universal gradient recycling via spin capacitance, ***Advanced Energy Materials***, 2024, 2403970.

[2] **S. Liao**, *et al*. Decoding the space charge storage in solid electrolyte interphase via operando magnetometry, submitted to ***Journal of the American Chemical Society***. (2025.7.19 Under Review)

[3] **S. Liao**, *et al*. Magnetic phase transition reveals ligand holes produced by charge transfer. (In Preparation)

[4] H. Liu[#], F. Zou[#], **S. Liao[#]**, *et al*. Reinterpreting the intercalation-conversion mechanism of FeP anodes in lithium/sodium-ion batteries from evolution of the magnetic phase, ***The Journal of Physical Chemistry Letters***, 2024, 15, 4694-4704.

[5] J. Chen, **S. Liao**, *et al*. Operando magnetometry decodes fast sodium storage: Biomass-derived Bi@NSC anodes with triple-phase kinetics, ***Chemical Engineering Journal***, 2025,166439, 1385-8947.

[6] L. Han, **S. Liao**, *et al*. Unlocking electrochemical potential: amorphous $NaFePO_4$ as a high-capacity and cycle-stable cathode material for advanced sodium-ion batteries, ***Science China Materials***, 2025, 68, 1109-1116.

[7] J. Chen, X. Guo, **S. Liao**, *et al*. Fresh sodium storage of FeCoNi alloys confined in biomass carbon revealed by operando magnetometry, ***Energy Storage Materials***, 2024, 71, 103600.

[8] Y. Liu, Y. Han, **S. Liao**, *et al*. In situ magnetometry study on the origin of anomalously capacity in transition metal sulfides, ***ChemPhysMater***, 2023, 2, 246-252.

[9] H. Fu[#], F. Gu[#], Y. Niu[#], **S. Liao**, *et al*. Spatially confined transition metals boost high initial coulombic efficiency in alloy anodes, ***Chemical Science***, 2025, 16, 418.

[10] X. Li, Z. Bu, H. Liu, L. Qin, B. Qiu, K. Sun, Z. Zhang, **S. Liao**, *et al.* Electrochemical Na doping to spent lithium-ion batteries takes on an entirely new look, ***Chemical Communications***, 2025, 61, 5349-5352.

PATENT

- Q. Li, **S. Liao**, *et al*. A Recycling Method for Lithium-Ion Batteries and Spin Capacitance Mechanism. Patent Application No. 2024116995691. Status: Application accepted and under review by CNIPA.

RESEARCH EXPERIENCE

Space Charge Behavior of SEI Probed by Fe_3C Magnetic Response

Duration: Apr. 2023 – Present Supervisors: Prof. Qiang Li

- Employed Fe_3C as a magnetic probe material to investigate space-charge storage behavior in the SEI layer

through operando magnetometry;

- Combined multi-scale characterization techniques to quantify an additional space-charge capacity of ~236 $mAh \cdot g^{-1}$ within the voltage range of 0.01–1.4 V;
- Demonstrated that the SEI functions as an ion-conductive interface that hosts spin-polarized electrons, enabling interface space-charge storage;
- This study provides new insights into the role of SEI in energy storage and interfacial ion-electron coupling behavior.

Magneto-electrochemical Study and Upcycling of $LiFePO_4$ Cathodes

Duration: Nov. 2023 – Apr. 2024 Supervisors: Prof. Qiang Li & Prof. Yuxiang Hu

- Investigated the charge storage mechanism of $LiFePO_4$ in the low-voltage window based on prior understanding of space-charge behavior;
- Analyzed the magneto-electrochemical response and spin accumulation characteristics of $LiFePO_4$ under varied electrochemical states;
- Proposed a strategy for direct upcycling of spent $LiFePO_4$ into high-performance supercapacitor materials via a gradient phase-reconstruction approach;
- The work offers a sustainable solution to battery material reuse and provides a new perspective on charge storage in cathode materials.

Ligand Hole Evolution in Layered Sodium-ion Cathodes

Duration: May 2024 – Present Supervisors: Prof. Qiang Li & Prof. Guoxing Miao

- Investigated ligand-to-metal charge transfer (LMCT) and ligand-hole generation in layered oxides using $Na_{2/3}Cu_{1/3}Mn_{2/3}O_2$ as a model system;
- Conducted joint characterization using operando magnetometry, X-ray absorption spectroscopy (XAS), and density functional theory (DFT) calculations to elucidate ligand-hole accumulation behavior;
- Identified an antiferromagnetic-to-ferromagnetic transition during electrochemical cycling, validating the hypothesis that oxygen activity modulates cathode performance via magnetic-state evolution;
- Observed similar magnetic-electronic responses in Ni-rich systems such as NCM811, leading to the proposal of a generalized magneto-electrochemical model for strongly hybridized materials;
- This work bridges electrochemistry and condensed matter physics, providing interdisciplinary insights into oxygen redox mechanisms in high-energy-density cathode materials.

Note: A complete research experience can be found on the homepage: *https://shuxuanliao.github.io/*.

HONORS

- Academic scholarships, Qingdao University, Academic Year 2022-2023, 2023-2024 and 2024-2025
- Best Poster Award, The 4th Asia-Pacific Conference on Energy Storage and Conversion, 2023
- Outstanding Student Award, Qingdao University, 2023
- Campus Innovation Pioneer, China (Qingdao) International Youth Entrepreneurship and Innovation Competition, 2022
- Second Prize, Provincial Level, China Undergraduate Mathematical Contest in Modeling (CUMCM), 2019
- Outstanding Student Cadre, Nanjing Tech University, 2019

SKILLS

Software: Origin, MS Office, Avantage, Vesta, MATLAB, etc.

Characterization: XRD, PPMS, EPR, XAS, TEM, SEM, DEMS, etc.

Languages: Mandarin Chinese (native), English (conversational).