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Research Interests

Battery Digital Twin, Battery Materials, Battery Characterization,

Professional Appointments

The University of Central Florida, Orlando, Florida

Assistant Professor in Materials Science and Engineering *12/2024-present*

- Joint appointment in the Resilient, Intelligent and Sustainable Energy Systems Cluster

Microvast Power Solutions, Lake Mary, Florida

Senior Scientist/Project Manager *07/2023-05/2024*

- Led a high-energy Li battery research team of three scientists/engineers, all holding Ph.D. degrees
- Developed on-board impedance/pressure measurement approaches for battery state of health estimation
- Developed key battery materials including Li foil, micro-sized silicon anode, single crystal cathodes and non-flammable electrolytes, prototyped high-energy pouch cells
- Led the writing of DOE-EERE seed grant (1.5 M) about sodium-ion and passed the first round of review

The University of Maryland, College Park

Postdoc Researcher, Supervisor: Dr. Wang, Chunsheng, Chair Professor *05/2022-07/2023*

- Designed a composite liquid electrolyte for micro-sized silicon || NMC pouch cells and extended the cycle lifetime from 10 to 200 cycles, achieved >99.8% cycling coulombic efficiency for micro-sized silicon and drafted a manuscript for publication in a high-profile journal
- Designed a new electrolyte that enables high voltage (> 4.4 V) operation of sodium-ion NFM cathodes and high coulombic efficiency of Na metal stripping/plating (> 98%)

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- Synthesized composite FeS_x /carbon cathode in a scalable solution-based approach, achieved 900 Wh kg^{-1} cathode energy density in all solid-state pouch cells made by Solid Power, renewed this project with IARPA

The University of Texas at Austin

Postdoc Researcher, Supervisor: Dr. Manthiram, Arumugam, Chair Professor

01/2021-04/2022

- Designed liquid electrolytes that enable fast sulfur cathode kinetics and high stability for Li^0 anode, published the results in Advanced Energy Materials and Angewandte Chemie, presented the data to Battery 500 consortium, and secured the next phase funding
- Designed Li anode protective layers based on air-stable sulfide/polymer composite and enabled stable cycling of lean electrolyte Li metal || NMC pouch cells (over 200 cycles), published the result in Advanced Energy Materials and Advanced Functional Materials

Vanderbilt University, Nashville, Tennessee

Postdoc Researcher, Supervisor: Dr. Hatzell, Kelsey, Assistant Professor

09/2019-12/2020

- Discovered the chemical interaction between solid sulfide electrolyte and an acrylate-based polymer binder, fabricated thin composite solid electrolyte, investigated its effects on stabilizing the anode, simulated the chemo-mechanical phenomena in the composite cathode, published the results in ACS Energy Letters and Journal of Electrochemical Society

Education

The Hong Kong University of Science and Technology, Hong Kong (CN)

Doctor of Philosophy in Mechanical and Aerospace Engineering

9/2015-8/2019

Supervisor: Dr. Zhao, Tianshou, Chair Professor

- Constructed an accurate numerical model for lithium-sulfur batteries; designed sulfur cathode based on the model; investigated the thermodynamics of different Li_2S_x and Na_2S_x compounds; published results in J. Power Sources multiple times; assisted with the application of the theme-based research project from Hong Kong SAR (HKD 50 million)
- Designed fluoride-rich protective layer for Li^0 anode with a scalable solution-based approach; designed a composite lithium/carbon interlayer to prelithiate and protect silicon anode; published results in Nature Communications, Energy Storage Materials, etc

Xi'an Jiaotong University, Xi'an (CN)

Bachelor of Engineering in New Energy Science and Engineering program

9/2011-6/2015

Selected Honors

- Hong Kong Postgraduate Fellowship Scheme (HKD 1.02 million, top 5%, 2015-2018)
- The Electrochemical Society travel grant (2018)
- Outstanding graduate of Xi'an Jiaotong University (top 3%, 2015)
- National Scholarship (top 5%, 2011-2013)

Expertise and Skills

- **Modeling:** COMSOL (electrochemistry, mechanics, and transport modules), Python, Matlab
- **Battery materials and battery cell design:** material synthesis and coating of high-capacity anodes (microsized silicon), high-nickel content cathodes, and conversion-type cathodes, formulation design of fluorinated liquid electrolytes and sulfide/polymer composite electrolytes, making and assembly of pouch cells
- **Characterizations:** electroanalytical techniques, DSC, TGA, mechanical measurement, Raman, FTIR, Operando XRD, XPS, NMR, Operando optical microscope

Presentations

1. **Ren, Y. X.**, Yonemoto, B., USABC quarterly review meeting, Lake Mary, FL (2023)
2. **Ren, Y. X.**, Invited talk for Albemarle Corporation, Kings Mountain, NC (2023)
3. **Ren, Y. X.**, Wang, C. S., IARPA project on-site review meeting, College Park, MD (2022)
4. Manthiram A., **Ren, Y. X.**, Battery 500 consortium quarterly review meeting, online (2022)
5. **Ren, Y. X.**, Zhao, T. S., Remedies of capacity fading in room-temperature sodium-sulfur batteries, ECS meeting, Seattle, WA (2018)
6. **Ren, Y. X.**, Zhao, T. S., An efficient Li₂S-based lithium-ion sulfur battery realized by a bifunctional electrolyte additive, ECS meeting, New Orleans, LA (2017)

Participated Grants

1. PI: Wang, C.S. (UMD), Zhang, P. (Solid Power), Long calendar life high energy solid-state batteries (track 2) IARPA resilience program, 01/2022-01/2024.
2. PI: Manthiram, A.(UT Austin), Liu, J. (PNNL), Battery 500 consortium, 09/2017-09/2027.
3. PI: Hatzell, K. (Vanderbilt), Understanding interfaces solid state energy storage systems and cross-disciplinary education and energy storage systems, NSF-2140472, 09/2019-09/2024.
4. PI: Zhao, T. S. (Hong Kong UST), Creation of rechargeable electron-fuels for stationary power supplies and electric vehicles, T23-601/17-R, 01/2018-01/2023.

Reviewers

- **Journal Reviewer:** Nature Communications, Advanced Energy Materials, Angewandte Chemie, etc.
- **Grant Reviewer:** NSF-GRFP (2025), ACS-PRF (2025), NSF-CBET/DMR (2025)

Publications

Google scholar citation > 2500; H index = 26; 21 first-author papers in Nature Communications, Angewandte Chemie, ACS Energy Letters, Advanced Functional Materials, Advanced Energy Materials, etc; 22 co-author papers in Nature Nanotechnology, Nature Materials and other journals

Modeling of Coupled Transport and Reaction Processes in Batteries

1. **Ren, Y. X.**, Jiang, H. R., Zhao, T. S., Zeng, L. & Xiong, C. Remedies of Capacity Fading in Room-Temperature Sodium-Sulfur Batteries. *J. Power Sources* 396, 304–313 (2018).
2. **Ren, Y. X.**, Zhao, T. S., Tan, P., Wei, Z. H. & Zhou, X. L. Modeling of An Aprotic Li-O₂ Battery Incorporating Multiple-Step Reactions. *Appl. Energy* 187, 706–716 (2017).
3. **Ren, Y. X.**, Zhao, T. S., Liu, M., Tan, P. & Zeng, Y. K. Modeling of Lithium-Sulfur Batteries Incorporating the Effect of Li₂S Precipitation. *J. Power Sources* 336, 115–125 (2016).

Design of Liquid Electrolytes and Anode Interphases

4. **Ren, Y. X.**, Zeng, L., Jiang, H. R., Chen, Q. & Zhao, T. S. Rational Design of Spontaneous Reactions For Protecting Porous Li Electrodes in Lithium-Sulfur Batteries. *Nat. Comm.* 10, 3249 (2019).

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5. **Ren, Y. X.**, Barghav, A., Shin, W., Sul, H., Manthiram, A. Anode-Free Lithium-Sulfur Cells Enabled By Rationally Tuning Lithium Polysulfide Molecules. *Angewandte Chemie International Edition*, 202207907 (2022).
 6. **Ren, Y. X.**, Manthiram, A. A Dual-Phase Electrolyte for High-Energy Lithium–Sulfur Batteries. *Advanced Energy Materials*, 2106680 (2022).
 7. **Ren, Y. X.**, Lai, T. X., Manthiram, A. Reversible Sodium–Sulfur Batteries Enabled by A Synergistic Dual Additive Design. *ACS Energy Letters*, 2746-2752 (2023).
 8. **Ren, Y. X.**, Zeng, L., Zhao, C., Xiong, C., Chen, Q. & Zhao, T. S. A Safe and Efficient Lithiated Silicon sulfur Battery Enabled by A Bi-Functional Composite Interlayer. *Energy Storage Materials* 25, 217-223 (2020).
 9. **Ren, Y. X.**, Zhao, T. S., Liu, M., Zeng, Y. K. & Jiang, H. R. A Self-Cleaning Li-S Battery Enabled by A Bifunctional Redox Mediator. *J. Power Sources* 361, 203–210 (2017).
 10. Liu, M., **Ren, Y. X.**, Jiang, H. R., Luo, C., Kang, F. Y. & Zhao, T. S. An Efficient Li₂S-Based Lithium-Ion Sulfur Battery Realized by A Bifunctional Electrolyte Additive. *Nano Energy* 40, 240–247 (2017). (# Equal)

Investigation of Solid-State Batteries and Chemo-Mechanical Phenomena

11. **Ren, Y. X.**, Hortance N. M., McBride J. R., Hatzell, K. B. Sodium-Sulfur Batteries Enabled by A Protected Inorganic/Organic Hybrid Solid Electrolyte. *ACS Energy Letter* 6, 345-353 (2021).
12. **Ren, Y. X.**, Shin, W., Manthiram, A. Operating High-Energy Lithium-Metal Pouch Cells with Reduced Stack Pressure Through a Rational Lithium-Host Design. *Advanced Energy Materials*, 202200190 (2022).
13. **Ren, Y. X.**, Cui, Z. H., Barghav, A., He, J. R., Manthiram, A. A Self-Healable Sulfide/Polymer Composite Electrolyte for Long-Life, Low-Lithium-Excess Lithium-Metal Batteries. *Advanced Functional Materials*, 2106680 (2021).
14. **Ren, Y. X.**, Hortance N. M., McBride J. R., Hatzell, K. B. Mitigating Chemo-Mechanical Failure In Li-S Solid State Batteries with Compliant Cathodes. *Journal of The Electrochemical Society* 169, 6 (2022).
15. **Ren, Y. X.**, Hatzell, K. B. Elasticity-Oriented Design of Solid-State Batteries: Challenges and Perspectives. *J. Mater. Chem. A.*, **9**, 13804-13821 (2021).