



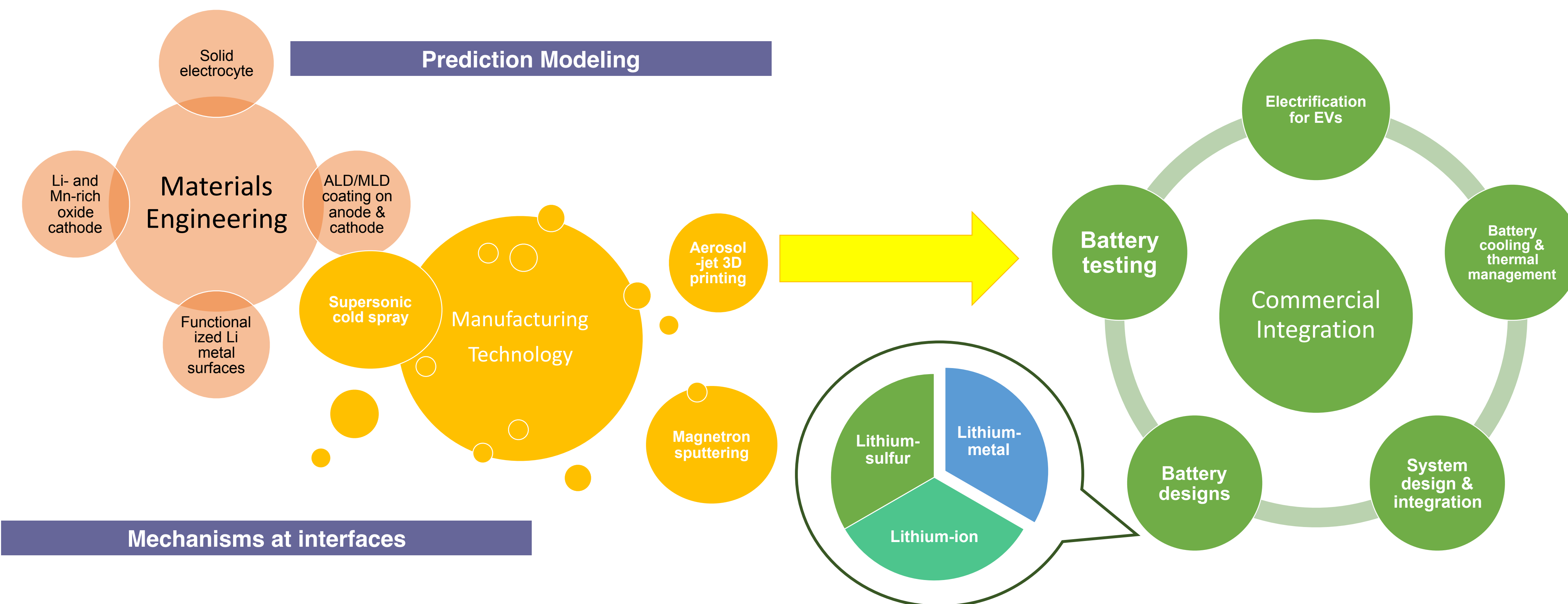
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Mission/Purpose

IUCRC-CEPS aims to:

- Develop eco-friendly, safe and economically feasible all-solid-state energy storage technology for portable and medical applications, automotive industry, electric grids, military applications, and energy security.
- Provide professional training for undergraduate and graduate students through modeling and hands-on laboratory experience.
- Work with industry in R&D, production development and provide service to industry in prototype development, battery testing, system integration.

Scope/Current Research

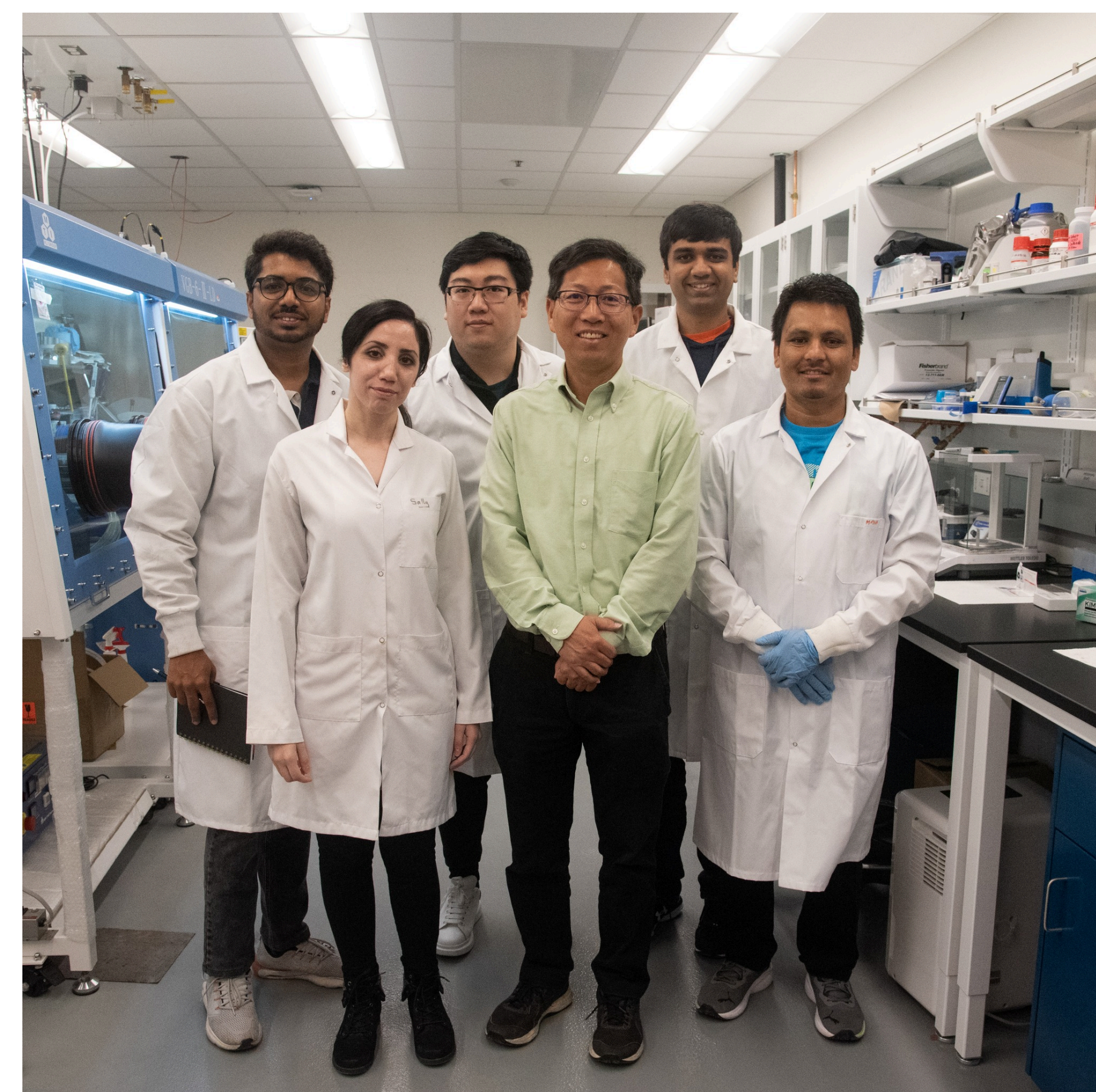


IUCRC-CEPS carries out battery technology development for a wide range of applications. Major areas are:

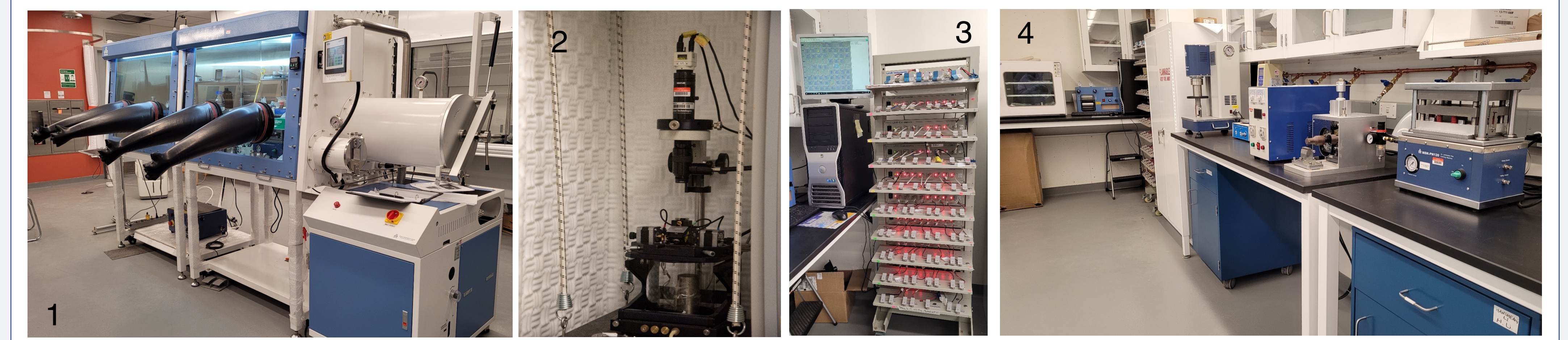
- Battery prototyping
- Battery materials and devices development
- Battery cell characterization
- Battery lifetime prediction
- Battery analytics
- Battery testing
- Li-/Mn rich oxide cathode
- Garnet and polysulfide solid-state electrolytes
- Li-metal battery development
- Battery management systems
- Battery pack electromechanical integration

Team Members

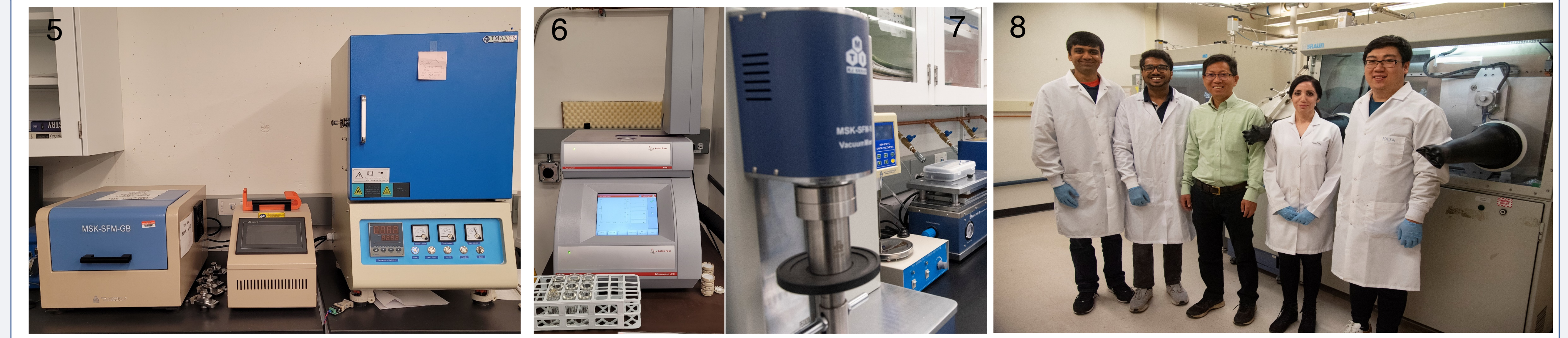
- Dr. Quinn Qiao, Professor, Director
- Dr. Sally Mabruk, Research Associate
- Mr. Raja Sekhar Bobba, Ph.D. Candidate
- Mr. Poojan Indrajee Kaswekar, Ph.D. Student
- Mr. Hansheng Li, Ph.D. Student
- Mr. Madan Bahadur Saud, Ph.D. Student
- Mr. Yuchen Zhang, Ph.D. Student



Capabilities



1) Ar-filled glovebox with coin cell crimper and pouch cell sealer; 2) Atomic Force Microscopy; 3) Multi-channel coin battery performance analyzing instruments; 4) Pouch cell component fabrication equipment line; 5) Solid materials processing station with planetary ball mill and muffle furnace; 6) Microwave reactor for wet material processing, equipped with automatic sampler; 7) Mixer; 8) Thermal evaporation-deposition chamber in N₂-filled glovebox;



Services

- Battery testing and analytics, battery cell characterization, battery lifetime prediction, battery management systems, and battery Pack Electromechanical integration
- Battery Materials, devices and systems R&D, battery prototyping
- Solar cell device fabrication, optical and electrical characterization
- Atomic Force Microscopy Analysis
- Workforce development (e.g., research experiences for graduate and undergraduates)

Projects

- Novel battery materials (anode, cathode, electrolyte, etc.), interfaces, and devices (Li-ion, Li metal, solid state batteries, etc.) development for higher safety, longer cycling and larger capacity battery technologies.
- Battery cell characterizations, system integration and remaining useful life prediction.
- Green off-grid audio-visual communication systems by photo-chargeable solid-state batteries
- Synthesis of sulfide electrolytes to develop all-solid-state battery having high energy density and long-term stability
- Microwave-assisted Li- and Mn-rich oxide cathode Developments
- Nanoscale mapping for charge carrier dynamics in polycrystalline semiconductors

Major Contributions/Output

- Silicon nitride stabilized interface between lithium metal and solid electrolyte for high performance lithium metal batteries, pending patent, 2022.
- Low-concentration electrolyte for suppressing dendrite growth in lithium metal, pending patent, 2022.
- Fluorinated hybrid solid-electrolyte-interphase for dendrite-free lithium deposition, Nature communications, 11, Article number: 93 (2020)
- Efficient tandem solar cells with solution-processed perovskite on textured crystalline silicon, Science, 367 (6482), 1135-1140, 2020
- Atomic force microscope-based instrumentation for probing nanoscale charge carrier dynamics with improved temporal and spatial resolution, US-11016118-B2 Grant 2021/05/25.
- Mitigating interfacial mismatch between lithium metal and garnet-type solid electrolyte by depositing metal nitride lithiophilic interlayer, ACS applied energy materials, 5, 1, 648-657, 2022
- Solar charging batteries: advances, challenges, and opportunities, Joule, 2(7), 1217-1230, 2018

Sponsors

National Science Foundation, Industry members including Nissan, Honda, Mercedes-Benz, Medtronic, Daktronics, PolyPlus, C4V, Dow Corning, Li-BAMA, Saint Gobain, VRC Metal Systems, etc.

