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Research Interests

Dr. Kaveevivitchai's research focuses on the design and development of advanced functional materials with complex nanostructures for high-performance energy storage technologies. During the period of her postdoctoral fellowship at Texas Materials Institute, the University of Texas at Austin, she was working side by side with world renowned researchers aiming at developing novel rechargeable batteries that are more sustainable and affordable. In order for our society to rely more on green renewable energy sources, e.g., solar and wind power, and to transition from internal combustion engine-based cars to fully electric vehicles, new energy storage devices superior to those of current technologies are needed. The science and engineering of advanced materials certainly remain at the forefront of finding viable solutions to the complex energy-related issues. For such large-scale energy storage devices, new Li-ion battery chemistries with an emphasis on cost, safety, and energy density are being pursued in her laboratory. Kaveevivitchai research group also focuses on developing new electrochemistries beyond lithium technology. Examples of these post-Li-ion batteries are Na-ion, Mg-ion, Zn-ion, Ca-ion, and Al-ion systems. The research studies will uncover the relationships between materials properties, electrode architectures, and underlying electrochemical mechanisms. In addition to the field of energy storage, the research topics are interdisciplinary involving the design and development of inorganic and hybrid redox-active materials, as well as porous functional materials, such as metal-organic (MOFs) and non-covalent organic (nCOFs) frameworks. The ability to design and fine-tune such solids in terms of pore sizes, shapes, structural diversity, functionality, and properties, essentially opens up many application possibilities, such as gas storage, photocatalysis, and molecular separations. Porous materials with charge mobility may have the potential in applications such as high-capacity electrodes, size-tunable electronic devices, and solid-state sensors.

Representative Publications

1. **Kaveevivitchai, W.**; Huq, A.; Manthiram, A. "Microwave-Assisted Chemical Insertion: A Rapid Technique for Screening Cathodes for Mg-Ion Batteries", *J. Mater. Chem. A* **2017**, *5*, 2309−2318.
2. Xue, L.; Li, Y.; Gao, H.; Zhou, W.; Lu, X.; **Kaveevivitchai, W.**; Manthiram, A.; Goodenough J. B. "A Low-Cost High-Energy Potassium Cathode", *J. Am. Chem. Soc.* **2017**, *139*, 2164−2167.
3. **Kaveevivitchai, W.**; Huq, A.; Manthiram, A. "Rechargeable Aluminum-ion Batteries Based on an Open Tunnel Framework", *Small* **2017**, *13*, 1701296.
4. **Kaveevivitchai, W.**; Jacobson, A. J. "Rechargeable Magnesium Batteries Based on a Microporous Molybdenum-Vanadium Oxide Electrode", *Chem. Mater*. **2016**, *28*, 4593−4601.
5. **Kaveevivitchai, W.**; Manthiram, A. "High-Capacity Zinc-Ion Storage in an Open-Tunnel Oxide for Aqueous and Nonaqueous Zn-Ion Batteries", *J. Mater. Chem. A* **2016**, *4*, 18737−18741.
6. **Kaveevivitchai, W.**; Jacobson, A. J. "Exploration of Vanadium Benzenedicarboxylate as a Cathode for Rechargeable Lithium Batteries", *J. Power Sources* **2015**, *278*, 265−273.
7. **Kaveevivitchai, W.**; Wang, X.; Liu, L.; Jacobson, A. J. "Two Distinct Redox Intercalation Reactions of

Hydroquinone with Porous Vanadium Benzenedicarboxylate MIL-47", *Inorg. Chem.* **2015**, *54*, 1822−1828.
8. Chen, T.-H.; Popov, I.; **Kaveevivitchai, W.**; Chuang, Y.-C.; Chen, Y.-S.; Daugulis, O.; Jacobson, A. J.; Miljanić, O. Š. "Mesoporous Fluorinated Metal-Organic Frameworks with Exceptional Adsorption of Fluorocarbons and CFCs", *Angew. Chem. Int. Ed*. **2015**, *54*, 13902−13906.
9. Chen, T.-H.; Popov, I.; **Kaveevivitchai, W.**; Miljanić, O. Š. "Metal-Organic Frameworks: Rise of the Ligands", *Chem. Mater.* **2014**, *26*, 4322–4325.
10. Chen, T.-H.; Popov, I.; **Kaveevivitchai, W.**; Chuang, Y.-C.; Chen, Y.-S.; Daugulis, O.; Jacobson, A. J.; Miljanić, O. Š. "Thermally Robust and Porous Noncovalent Organic Framework with High Affinity for Fluorocarbons and CFCs", *Nat. Commun.* **2014**, *5*, 5131−5138.
11. **Kaveevivitchai, W.**; Jacobson, A. J. "High Capacity Microporous Molybdenum-Vanadium Oxide Electrodes for Rechargeable Lithium Batteries", *Chem. Mater*. **2013**, *25*, 2708–2715.

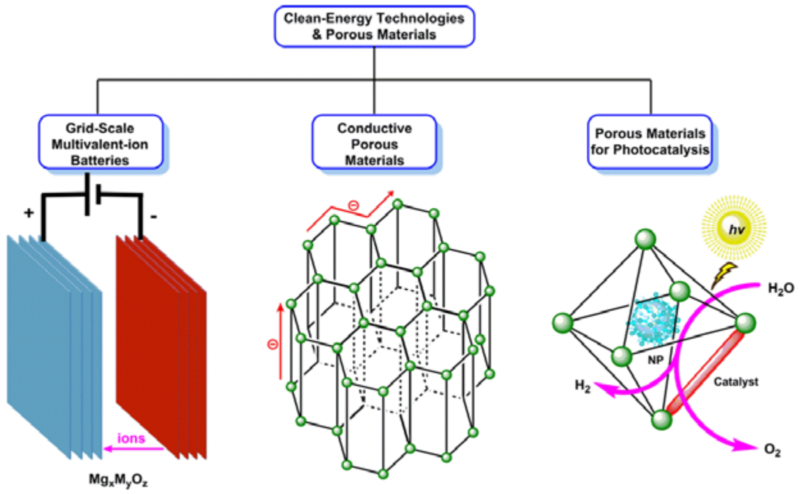

Figure 1. The overarching research theme for emerging clean-energy technologies, focusing on materials properties, electrode architectures, and mechanisms.

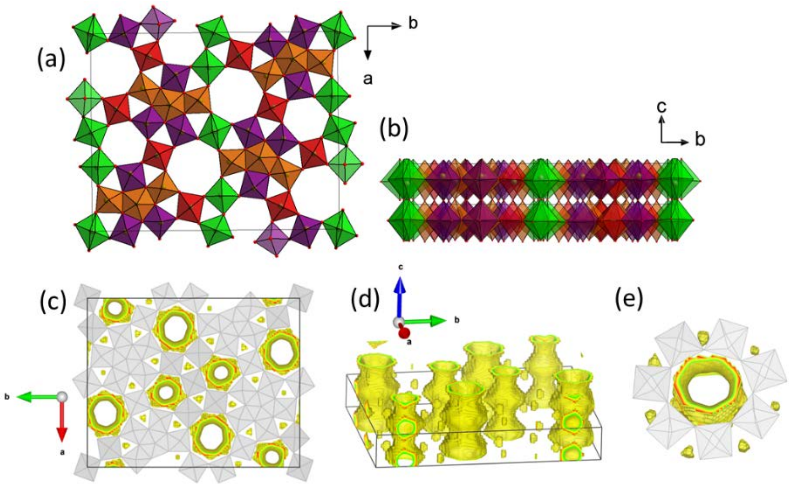

Figure 2. (a) and (b) Structure of $Mo_{2.5+y}VO_{9+z}$ used as battery cathode (M = Mo and V cations predicted theoretically with different oxidation states and occupancies: green, Mo^{5+}/V^{4+}; red, Mo^{6+}/V^{5+}; orange, Mo^{5+}; and purple, Mo^{6+}). (c) to (e) Bond valence sum (BVS) maps showing the conduction pathway of multivalent cations in the channels of the microporous framework [1].

Figure 3. Post-synthetically modified vanadium-based MOF showing intercalated quinhydrone complexes capable of proton-electron transfer reaction in the channels: (a) view along the *c*-axis; (b) portion of the channel displaying two quinhydrone complexes in space-filling representation [7].