Department of Chemistry Seminar Series
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Advanced Materials Design for High Energy Density Rechargeable Batteries

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Redox-active porous organic frameworks have emerged as a unique platform for electrochemical energy storage due to their high surface area, tunable physicochemical properties, and lightweight. In this talk, we present the concept of porous materials design and synthesis and highlight the impact of textural and chemical properties of extended frameworks on energy storage. The use of crystalline covalent organic frameworks as electrode materials in rechargeable sodium batteries will be presented. We demonstrate the performance of azo-linked porous polymers (ALPs) and covalent organic frameworks (Aza-COFs) in sodium ion storage and show how the design of the frameworks dictates redox properties, capacity, and power density. These highly cross-linked frameworks are insoluble in electrolytes and have π-conjugated skeletons with readily accessible redox-active sites which enable high specific capacity and superior cycling stability and rate capability. Our recent studies provide new directions to address the current challenges of limited lithium resources and the toxicity of metals used in conventional cathode materials.

References

1. Shehab, M. K., Weeraratne S. K., El-Kadri, O., M., Yadavalli, V. S., El-Kaderi, H. M. “Templated Synthesis of two-Dimensional Polyimide Covalent Organic Framework for Rechargeable Sodium-Ion Batteries” *Macromolecular Rapid Communications*, **2023**, 2200782.
2. Shehab, M.; Weeraratne, K.; Huang, T.; Lao, K. U.; El-Kaderi, H. M. “Exceptional Sodium-Ion Storage by Aza-Covalent Organic Framework for High Energy and Power Density Sodium-Ion Batteries” *ACS Applied Materials & Interfaces,* **2021**, *13*, 15083–15091.
3. Weeraratne, K. S.; Alzharani, A. A.; El-Kaderi, H. M. “Redox-Active Porous Organic Polymers as Novel Electrode Materials for Green Rechargeable Sodium-Ion Batteries.” *ACS Applied Materials & Interfaces* **2019,** *11*, 23520-23526.

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