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# From electrons to $CO_2$: Proton-coupled electron transfer redox molecules for energy storage and carbon capture

Presented by:

**Assistant Professor Yan Jing**
Department of Materials Science and Engineering, National University of Singapore

Date: **3rd Sep 2026, Thursday** Time: **10:00am-11:00am**

Venue: **Block EA, Level 6, EA-06-03 Seminar Room (Map)**

Hosted by: **Associate Professor Daria Andreeva-Baeumler**

**Abstract:**
Composed of earth-abundant elements, water-soluble organic redox molecules hold great promise as electrolyte species for aqueous organic flow batteries, which are well suited for large-scale, long-duration energy storage because their energy and power capacities can be independently scaled. In aqueous media, many redox-active molecules undergo proton-coupled electron transfer (PCET). This behavior can generate a reversible pH swing during electrochemical redox cycling, providing an attractive mechanism for capturing $CO_2$ from dilute sources and subsequently releasing it as a concentrated or pure stream. For both energy storage and carbon capture applications, molecular engineering plays a critical role in developing PCET-active redox molecules that combine low cost, long lifetime, high solubility, and favorable electrochemical properties.
In this presentation, I will first discuss why both long-duration energy storage and carbon capture are indispensable for achieving global carbon neutrality by mid-century. I will then use two “molecularly edited” redox cores to illustrate how subtle structural modifications through “atom swapping” can profoundly influence the physical and electrochemical properties of the resulting molecules, thereby determining their suitability for energy storage, carbon capture, or both. By leveraging the unique characteristics of PCET-active redox molecules, I will further demonstrate enhanced energy storage integrated with carbon capture and utilization within a single electrochemical flow system. If time permits, I will conclude by discussing how the redox-targeting concept can be extended to electrochemical direct air capture.

**Biography:**
Dr. Yan Jing is an Assistant Professor in the Department of Materials Science and Engineering at the National University of Singapore (NUS). Prior to joining NUS, he completed his Ph.D. at the University of Houston and postdoctoral training at Harvard University. His previous research has advanced the development of aqueous anthraquinone flow batteries and contributed to the launch of Quino Energy, a startup that licensed his patented technology. His current research focuses on the development of redox-active materials and system design for energy storage, carbon capture, and redox-mediated chemical manufacturing.

Looking forward to seeing all of you!