**Tailored Design of Materials and Systems for Sustainable and Efficient Next Generation Batteries**

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The future energy storage alternatives such as lithium-air (Li-O2 and Li-CO2) batteries and Na-ion batteries have drawn much attention to replace conventional Li-ion batteries. First, Li-air batteries operate via distinct surface reactions that form (discharging) and evolve (charging) solid lithium-oxide products. To facilitate reaction reversibility, the air electrode for Li-air cells often requires an efficient catalyst. Yet insulating solid products formed during discharging often deactivate the catalyst surface, making product evolution difficult. Therefore, new catalyst chemistries and catalytic system architectures should be considered to alleviate electrode deactivation and offer continuous catalytic function. As another candidate, Na-ion batteries have been considered an alternative owing to lower costs, the abundance of Na resources, and analogous battery structure & reaction chemistry with existing Li-ion battery systems. However, unlike Li-ion batteries, current studies on Na-ion batteries have often confronted problems related to the insufficient Na storage capacities of electrode materials, especially anode materials, originating from the larger ionic radius of Na compared with Li (e.g. Li+: 0.76 Å, Na+: 1.02 Å) and instability issue on Na accommodation site. Therefore, the development of high capacity anode materials that enable facile insertion/extraction of Na ions is essential for high performance Na-ion batteries.

In this presentation, recent strategies to improve the performance and efficiency of next generation batteries issue will be introduced: (i) catalyst materials and systems for Li-O2 and Li-CO2 batteries and (ii) new electrode materials for Na-ion batteries.