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Material Designs for Sustainable Aqueous Batteries

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Energy storage systems play a crucial role in the integration of renewable energy sources, which are often unstable and intermittent, such as solar and wind power. These systems ensure a reliable and consistent energy supply by storing excess energy generated during peak production times and releasing it when production is low. Non-aqueous lithium-ion batteries dominate the battery market due to their high energy density, which allows them to store a large amount of energy in a relatively small volume. However, these batteries have a significant drawback: they are flammable. This flammability poses a risk of catastrophic damage, especially in large-scale applications where safety is paramount. Aqueous redox flow batteries (RFBs) offer a promising alternative for scalable, safe, and long-duration energy storage. One of the key advantages of RFBs is their design flexibility, which allows for independent scaling of power and energy capacity. This makes them highly adaptable to various energy storage needs. However, the widespread adoption of all-vanadium redox flow battery is limited by the low abundance and high cost of vanadium, making them less economically viable for large-scale deployment. In this presentation, we will discuss the development of emerging flow battery systems offering low-cost and high-capacity energy storage. We will discuss innovative approaches to mitigate crossover and improve reaction kinetics, thereby making these batteries more efficient and reliable.

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