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Long Cycle Life Sodium-Ion Batteries for Grid-Scale Energy Storage

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Abstract

With high penetration of renewable energy for future power systems, electrical energy storage (EES) systems are indispensable to provide predictable and dispatchable supply of electricity from intermittent renewable energies (e.g., solar, wind and wave). The emerging artificial intelligent (AI) data centers also require backup systems to offer uninterrupted electricity. In these regards, Li-ion batteries (LIBs) have been shown to play a critical role in achieving these goals as demonstrated by Tesla's 100MW Hornsdale Power Reserve installed in Australia. However, broad market penetration of LIB systems for all levels of EES, including electricity generation site storage, electricity transmission-substation storage, community storage and end user storage, is facing an insurmountable challenge, i.e., there is not enough Li in the world to meet the EES demand. In contrast, Na-ion batteries (NIBs) are an attractive alternative to LIBs for large scale, stationary energy storage because Na is highly abundant, behaves similarly to Li electro-chemically, and is low in cost. Furthermore, Na-based anodes allow the use of aluminum as a current collector which does not form a binary alloy with Na, leading to further reduced cost. In this plenary presentation, the key requirements for grid-scale energy storage, major anode and cathode materials of NIBs, their synthesis and electrochemical properties (particularly their cycle life) will be highlighted. Future directions for NIBs will be discussed as well.