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Both cationic and anionic redox chemistry in a P2-type sodium layered oxide

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Editorial Note

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EDITORIAL NOTE

High-energy oxygen redox chemistry in layered transition metal oxide cathodes has been the focus of intense research due to the need for high-energy Na-ion batteries. Most layered cathodes with oxygen redox, on the other hand, can experience irreversible electrochemical reactions, rapid ability decay, and underlying O2 release. We show that a copper element with a high electronegativaty can stabilise the Na-deficient P2-Na2/3Mn0.72Cu0.22Mg0.06O2 process, allowing both cationic and anionic redox chemistry to be achieved. As Na+ ions are removed and added, hard and soft X-ray absorption spectra indicate that both Mn3+/Mn4+, Cu2+/Cu3+, and O2/(O2)n participate in the redox reaction. The strong covalency between copper and oxygen ensures cationic and anionic redox activity in the P2-Na2/3Mn0.72Cu0.22Mg0.06O2 process, according to DFT calculations.

The P2-Na2/3Mn0.72Cu0.22Mg0.06O2 cathode has a long cycling life of 87.9% power retention at 1C after 100 cycles and a high rate output of 70.3 mA h g1 cycled at 10C. Our findings not only provide promising recommendations for improving the electrochemical performance of layered oxides based on anionic redox behaviour, but they also dig deeper into the science of the oxygen redox process. Using a strong electronegative copper element, a new Na-deficient P2-Na2/3Mn0.72Cu0.22Mg0.06O2 phase with both cationic and anionic activity has been discovered. As solid-solution Na+ ions are removed and added, the tight covalency between copper and oxygen promises cationic and anionic redox chemistry. As a result, this step may be able to provide stable cycling life in both Na-half cells and Na-half cells. P2-Na2/3Mn0.72Cu0.22Mg0.06O2 is a new Na-deficient process with both cationic and anionic activity. Because of the high covalency between the Cu 3d and O 2p orbitals, cationic and anionic redox chemistry is possible. In both half and complete Na-ion cells, this new Na-deficient P2-Na2/3Mn0.72Cu0.22Mg0.06O2phase could provide stable cycling life.