

Highly efficient, cost effective and safe sodiation agent for high performance sodium batteries

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Abstract

The development of sodium-ion batteries has been hindered so far by large irreversible capacity of hard carbon anodes and other anode materials in the initial few cycles, as sodium emanating from cathode materials is consumed in the formation of solid electrolyte Interface (SEI) and irreversibly trapped in anodes. Herein we report the successful synthesis of an environmentally benign and cost effective sodium salt ($\text{Na}_2\text{C}_4\text{O}_4$) that could be applied as additives in cathodes to solve huge irreversible capacity issues of anodes in sodium-ion batteries. When added in $\text{Na}_3(\text{VO})_2(\text{PO}_4)_2\text{F}$ cathode materials, the cathodes delivered a high stable capacity of 135 mAhg⁻¹ and stable cycling performance. The water stable $\text{Na}_3(\text{VO})_2(\text{PO}_4)_2\text{F}$ cathodes in combination with water soluble sacrificial salt eliminates the need for using any toxic solvents for laminate preparation thus paving way for greener electrode fabrication techniques. A 100% increase in capacity of sodium cells (full-cell configuration) has been observed with the new sodium salt at a C- rate of 2C. Regardless of the electrode fabrication technique this new salt finds use in both aqueous and non-aqueous cathode fabrication techniques in sodium batteries.