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Electrochemical properties of $Na_xMnFe(CN)_6 \cdot zH_2O$ synthesized in a Taylor-Couette reactor as a Na-ion battery cathode material

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Abstract

Taylor-Couette reactors allow short reaction times and enable the synthesis of powders with uniform particle size, and thus are suitable for preparing secondary battery cathode materials. Herein, cubic, monoclinic, and rhombohedral $Na_xMnFe(CN)_6 \cdot zH_2O$ samples were prepared in a Taylor-Couette reactor at various drying conditions/temperature and were shown to exhibit structure-dependent electrochemical properties.

When cycled at 0.1 C in a potential range of 2.0–4.0 V, cubic-, monoclinic-, and rhombohedral-structured samples exhibited reversible discharge capacities of 89.5, 91.4, and 150.1 mAh g^{-1}, respectively. Importantly, the rhombohedral-structured sample not only showed the highest reversible discharge capacity but also exhibited excellent capacity retention (88.03%) after 50 cycles at 0.5 C (300 mA g^{-1}), which was ascribed to its extremely low interstitial water content.

Keywords: electrode materials, chemical synthesis, crystal structure, X-ray diffraction, thermal analysis

1. Introduction

Li secondary batteries, developed in the early 1990s, are currently the main power source of portable electronic devices, exhibiting an application range encompassing both small electronic devices and large-scale systems such as electric vehicles and battery-based power systems [1,2]. However, the mass production of large-scale energy storage systems based on Li-ion batteries is