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Prussian Blue [$K_2FeFe(CN)_6$] Doped with Nickel as a Superior Cathode: An Efficient Strategy To Enhance Potassium Storage Performance

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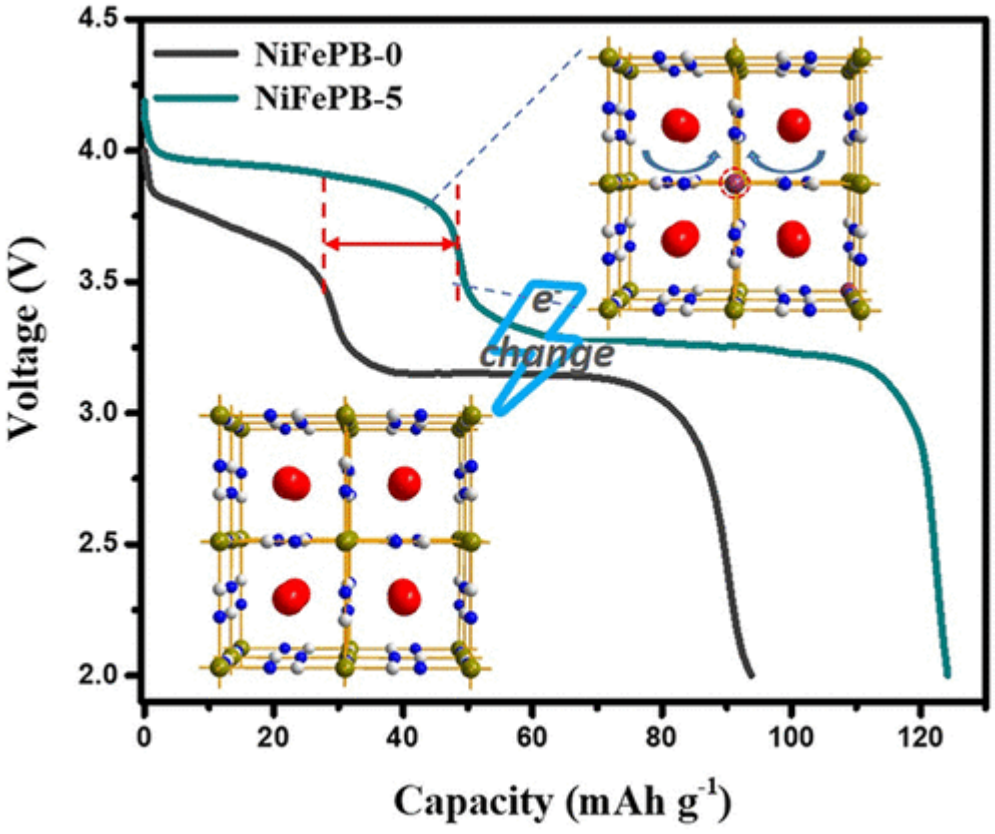
Abstract



Prussian blue (PB) and its analogues have been widely investigated as promising cathode materials for potassium ion batteries (PIBs) on account of their 3D open framework, which makes the intercalation/deintercalation of K^+ ions easy and quick. However, the PB materials usually exhibit limited rate capacity and poor cycling performance, preventing their development and practical application. In this work, PB doped with nickel ions via a modified coprecipitation method was explored to improve the rate capacity and cycling performance of PIBs, and the effect of Ni doping on the materials' performance was systematically studied. The optimal sample, 5% Ni-doped PB, delivered an enhanced discharge capacity of up to 135 mAh g^{-1}, compared to 120 mAh g^{-1} with nondoped PB. Our optimal sample also displayed excellent cycling performance with 83.1% capacity retention after 300 cycles (0.1 A g^{-1}) and declining just 0.0059% per cycle from 150 to 300 cycles. The discharge capacity at the high-voltage plateau increased from ~40 up to 53 mAh g^{-1}, offering a higher energy density for PIBs. On the basis of the characterization results, we ascribe the improved performance to the activation of nickel ions during the $Fe^{2+}C_6/Fe^{3+}C_6$ redox reaction.

KEYWORDS:

- Prussian blue analogue
- Nickel doping
- Potassium ion batteries
- Accelerative effect