Synthesis and Characterization of Prussian Blue Analogues as Cathodes for Sodium-ion Batteries

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Owing to the natural abundance of Na on Earth's crust and its similar chemical reactivity as compared to Li, Sodium-ion batteries (SIBs) have rapidly emerged as a suitable alternative to existing Li-ion batteries [1]. Nevertheless, the development of low-cost cathode materials is still a critical point for these systems. Among the cathode materials, Prussian blue and its analogues (PBAs) are regarded as some of the most promising compounds, thanks to their open framework for fast ion diffusion, possibility to tune their composition and low cost of the constituent elements [2]. However, according to the synthetic approach and the sodium content, these compounds can exhibit a number of different structures, often with a high amount of defects if interstitial water is incorporated, due to the substitution of $Fe[CN]_6$ groups [3]. In this work, we propose a simple room-temperature synthesis of a mixed Fe,Mn PBA by coprecipitation under inert atmosphere. The synergistic effect of acetylsalicylic acid as a complexing agent for Mn^{2+} ions, and sodium ascorbate as both a complexing agent and antioxidant molecule [4,5], is evaluated during the synthesis to slow down the formation of the compound and provide a material with a high Na content and a low number of structural defects. The synthesized material demonstrated no sodium deficiency, good performance (120-130 mAh g^{-1} at C/5) and capacity retention upon cycling (75 % after 100 cycles), as well as a high coulombic efficiency and good rate capability up to a current as high as 10C, hence showing promising results for a possible application in full cell configuration.

References

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