

One Step Hydrothermal Synthesis of $\text{Fe}_{1.19}(\text{PO}_4)(\text{OH})_{0.57}(\text{H}_2\text{O})_{0.43}$ composite cathode material and Its Electrochemical Properties in Li-Ion Batteries

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Lithium-ion batteries (LIBs) have been widely applied as a power source for portable and stationary energy storage systems. In this work, we report the electrochemical performance of FPHH/CB and FPHH/CNT cathode materials for Li-ion batteries where FPHH represents $\text{Fe}_{1.19}(\text{PO}_4)(\text{OH})_{0.57}(\text{H}_2\text{O})_{0.43}$ while carbon black (CB) and carbon nanotubes (CNT) were used as precursors in the one-pot hydrothermal synthesis. We show that the addition of conducting carbon black into the solution has a strong influence on reducing the particle size and tailoring their morphology. Thanks to its favorable microstructural characteristics, the FPHH-10 wt% C and FPHH-20 wt% C materials exhibited good performance [1]. The CNT also improve the performance of FPHH such as capacity retention. The study of the reaction mechanism of FPHH/CNT during cycling by combining *operando* XRD and ^{57}Fe Mössbauer spectroscopy (**Figure 1**) shows that the insertion mechanism is a monophasic reaction with 10% volume variations associated to the $\text{Fe}^{3+}/\text{Fe}^{2+}$ redox reaction [2].

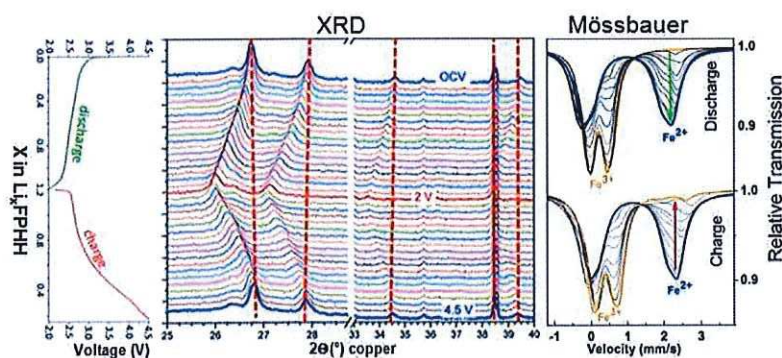


Figure 1. Voltage curve (left), operando XRD patterns (middle) and operando ^{57}Fe Mössbauer spectra (right) of FPHH/CNT for the first discharge–charge cycle at C/20.

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References

1. C. Karegeya, A. Mahmoud, R. Cloots, B. Vertruyen, F. Boschini, *Electrochimica Acta* 250 (2017) 49-58.
2. A. Mahmoud, C. Karegeya, M. T. Sougrati, J. Bodart, B. Vertruyen, R. Cloots, P-E. Lippens, F. Boschini. *ACS Applied Materials and interfaces* 10 (2018) 34202-34211.