P16-CFQ

ON THE ELECTROCHEMICAL BEHAVIOR OF IRON SUBSTITUTED $Na_3V_2(PO_4)_3$/C NANO COMPOSITES AS CATHODE MATERIALS FOR Na-ION BATTERIES.

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Sodium is an abundant and non-toxic alkali element with outstanding electrochemistry that places sodium batteries as serious competitors of lithium batteries for large-scale stationary energy storage. Transition metal phosphates exhibiting a NASICON-type structure offer a rigid framework with interconnected vacant sites facilitating the insertion and fast diffusion of alkaline ions.[1],[2]. $Na_3V_{2-x}Fe_x(PO_4)_3$/C nanocomposites ($0 \le x \le 0.5$) were synthesized by the sol-gel method. The carbon matrix notoriously improved the conducting properties of the raw material.

XRD patterns of these samples are characterized by narrow reflections corresponding to well-crystallized phases. On increasing the iron content, the cell volume increases due to the slightly higher radius of Fe^{3+}. Figure 1 shows $Na_3V_{1.7}Fe_{0.3}(PO_4)_3$ particles with non-homogeneous shape and size in the nanometric range. Cyclic voltammetry showed two signals at ca. 3.5 and 4.0 V, which evidence a linear dependence of potential on the level of substitution. The appearance of the short plateau at ca. 4.0 V is closely related to the higher iron substitution levels. The evaluation of XPS and ^{57}Fe Mössbauer spectra of charged and discharged electrodes allowed ascribing the 4.0 V plateau to the V^{4+}/V^{5+} redox reaction and the reversible insertion of extra sodium ions from octahedral M1 sites. Galvanostatic cycling showed capacity values as high as 115 mA h g^{-1} for samples with x= 0.1, 0.2, 0.3 and exceptional cyclability (Figure 2).[3]

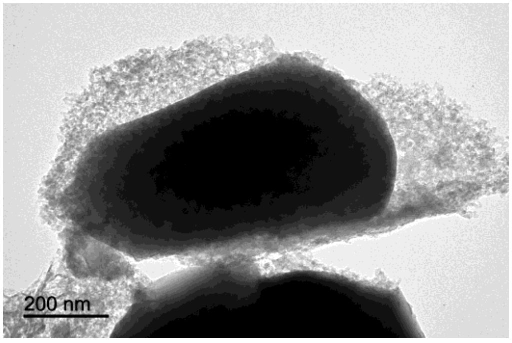

Figure 1: Transmission electron micrograph of $Na_3V_{1.7}Fe_{0.3}(PO_4)_3$.

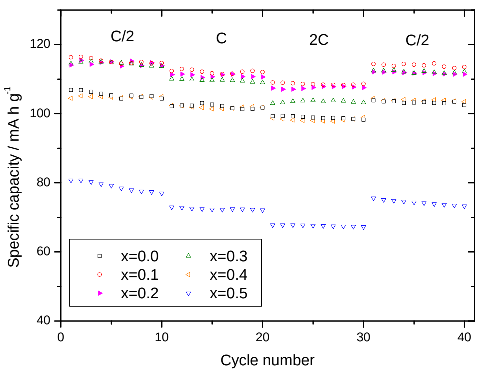

Figure 2: Capacity versus the number of cycles of sodium cells assembled with $Na_3V_{2-x}Fe_x(PO_4)_3$ ($0 \le x \le 0.5$).

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[3] Aragón, M. J.; Lavela, P.; Ortiz, G. F.; Tirado J. L. *J. Electrochem. Soc.*, **2015**, *162*, A3077.