P2-$Na_xCo_{1-y}Ti_yO_2$: a high performance cathode material for sodium ion batteries

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Abstract:

Sodium ion batteries have attracted a wide attention in recent years thanks to the tempting properties that sodium, the main component of this technology, offers. It is worth noting that sodium has a homogeneous distribution in the earth crust and exhibits similar reaction mechanism to the conventionally used lithium [1].

Different compounds, in particular layered oxides, are successfully used as cathode materials for Lithium ion batteries. Oxides are, therefore, studied in the present work and their suitability for sodium ion batteries is investigated. $LiCoO_2$, typically used in Li-based batteries, was replaced by Na_xCoO_2. The intercalation/deintercalation of sodium ions in this material occurs with the existence of well-defined steps in the potential window 2.0 - 3.8 V, i.e. during the charge/discharge process. The existence of potential steps in V vs composition curve, is due to structural transitions, thus affecting the electrochemical process. [2]. Knowing that $Na_{0.66}Co_{0.5}Ti_{0.5}O_2$ exhibits a reduced number of plateaus in the potential range 2-4.2 V [3], the present work aims to investigate how the change of Co/Ti composition ratio in the cathode affects the performance of the Na-ion battery.

$Na_yCo_{1-x}Ti_xO_2$ reveals a P2-type structure that delivers a first discharge capacity of 116 mAh/g with a good capacity retention. In-situ synchrotron XRD shows that the P2 type structure is practically preserved during the cycling, confirming judicious choice of titanium substitution.

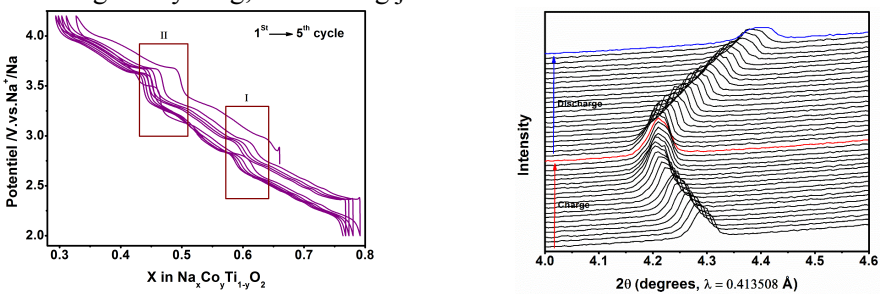

Figure1: Charge and discharge curves of $Na_xCo_{1-y}Ti_yO_2$ and the evolution of the (002) peak, data from the MSPD beamline at ALBA.

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Contribution: Oral