

Na₂Mn₃O₇: A Suitable Electrode Material For Na-ion Batteries ?

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Among the cathodes of the sodium ion batteries, the manganese based oxide materials present many advantages due to their high energy density, low-cost and low-toxicity. In particular, numerous layered materials have been reported in the system Na-Mn-O. These materials are interesting because they show weak interlayer interactions with free space allowing sodium diffusion. Here, we report for the first time the electrochemical activity of another lamellar phase of this system: Na₂Mn₃O₇ [1]. This material, synthesized by a conventional solid-state method, consists of [Mn₃O₇²⁻] layers built up with edge sharing MnO₆ octahedra, separated by NaO₆ and NaO₅ polyhedra. The galvanostatic cycling of this material have been performed at rate of C/20 (i.e. 1 Na⁺ in 10h) in the potential window 1.5–3.0 V versus Na⁺/Na. Starting from Na₂Mn₃O₇, a reversible capacity of 2 Na/f.u. (160 mAh/g) is obtained through a plateau at 2.1 V with a low polarization of 100 mV. The PITT curve reveals a bell shape type response on the reversible phenomena, which illustrates, together with the sharpness of the peaks in the derivative curve dQ/dE, that the reversible process is biphasic. Thus, the electrochemical process allows a reduced phase Na₄Mn₃O₇ to be obtained, which can intercalate/de-intercalate two sodium per f.u., reversibly. The ex situ XRD patterns obtained for this reduced phase suggest a large atomic rearrangement with the formation of a new structure with the composition Na₄Mn₃O₇, without amorphization and/or increase of disordered and stacking faults. The mechanism of insertion as well as the structures of the as-prepared and reduced phase will be discussed in this presentation.

References:

[1] E. Adamczyk and V. Pralong, Chem. Mater. 2017, 29, 4645–4648