Structural investigations of orthorhombic V_2O_5 nanowires in the full cell with magnesiated Mo_6S_8 anode

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The V_2O_5 cathode is known to be good material for lithium and magnesium insertion[1,2]. Therefore, it is a possible candidate as cathode material in magnesium-ion batteries. As known, the lithium insertion into V_2O_5 has already been very well studied[1]. However, only limited work focuses on the structural investigation upon Mg insertion into V_2O_5. For example, Gershinsky et al. [3] reported that *ex situ* XRD confirmed the insertion of Mg into the crystal structure with a reversible capacity of ~ 150 mAh g^{-1} for V_2O_5 thin film in the potential range 2.2 -3.0 V vs. Mg^{2+}/Mg. The detailed structural investigation of bulk V_2O_5 cathode in the whole insertion and extraction processes is still missing.

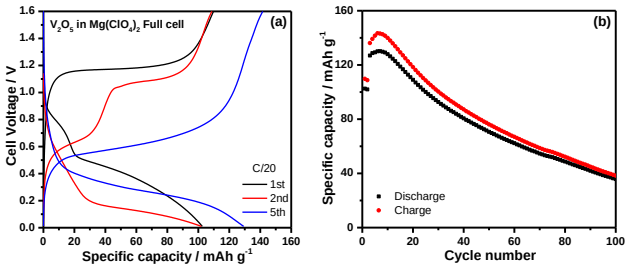

Figure 1: Discharge-charge profiles (a) and cycling performance (b) of V_2O_5 | $Mg(ClO_4)$/AN | $Mg_xMo_6S_8$ (x~2) full cell (C/20) in the voltage range of 1.6-0.01 V.

In the present work, orthorhombic V_2O_5 Nanowires were successfully synthesized via a hydrothermal method. A cell was first made to obtain the pre-magnesiated Mo_6S_8 anode due to the incompatibility of metallic Mg with chosen "standard" electrolyte. A full cell system was built using V_2O_5 as cathode, 1M $Mg(ClO_4)_2$ in acetonitrile (AN) and $Mg_xMo_6S_8$ (x~2) anode. The V_2O_5 nanowires deliver an initial discharge/charge capacity of 100 mAh g^{-1}/114 mAh g^{-1} and the highest discharge capacity of 128 mAh g^{-1} in the 5th cycle at C/20 rate in the full cell [4].

The structural evolution and oxidation state and local structural changes and the reversibility of the Magnesium insertion/extraction in the V_2O_5 were studied in the above mentioned full-cell system. The formation of the new phase Mg-rich $Mg_xV_2O_5$ during Mg insertion and the recovery of V_2O_5 during Mg extraction were identified via *in situ* synchrotron diffraction and *ex situ* Raman. The reduction/oxidation of vanadium during the Mg insertion/extraction was confirmed by *in situ* X-ray absorption spectroscopy (XAS) and *ex situ* XPS.

References

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