Journal of
Materials Chemistry

Cite this: DOI: 10.1039/c0xx00000x

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COMMUNICATION

Coated hybrid of V_2O_5 nanowires with MWCNTs by polypyrrole as anode material for aqueous rechargeable lithium battery with excellent cycling performance

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Received (in XXX, XXX) Xth XXXXXXXXX 20XX, Accepted Xth XXXXXXXXX 20XX
DOI: 10.1039/b000000x

Electronic Supporting Information:

1. Testing methods and the preparation of electrodes

After powdered, the obtained hybrids were analyzed by X-ray diffraction (XRD) on a Bruker D4 X-ray diffractometer with Ni-filtered CuK_α radiation (PANalytical Empyrean). SEM micrographs were obtained by a Philip XL30 operated at 25 kV. Transimmission electron micrographs (TEM) were got by a JEOL JEM-2010 transmission electron microscope. X-ray photoelectron spectroscopy (XPS) testing was measured on a 5000C ESCA from PHI Perkin-Elmer.

The working electrode was prepared by pressing a mushy mixture of the home-made $LiMn_2O_4$ or V_2O_5 hybrid, acetylene black and poly(tetrafluoroethylene) (PTFE) (in a weight ratio of 7.5/8:1.5/1:1) dispersed in ethanol onto Ni-grid. The cyclic voltammetry (CV) was measured by an electrochemical work station (CHI604C, Chenhua Ltd. Co., Shanghai, China) at the scan rate of 5 mV/s. The electrochemical impedance spectra (EIS) were recorded by the same electrochemical work station from 10^5 to 1 Hz and the amplitude of the used perturbation was 10 mV.

The galvanostatic charge-discharge tests of the electrodes were performed at a cell tester (Land) using a three-electrode cell, where activated carbon electrode and saturated calomel electrode (SCE, 0.242 V *vs*. NHE: normal hydrogen electrode) were used as the counter and reference electrodes, respectively. Its electrochemical impedance was measured by using Ni-grid as the counter electrode. The long-term cycling of $LiMn_2O_4$ / 0.5 M Li_2SO_4 / hybrid V_2O_5 system (weight ratio for the cathode and anode is 1:2) was performed in a two-electrode cell between 1.75 and 0.8 V. Aqueous Li_2SO_4 solution (0.5 M) was used as the electrolyte.

All the above measurements were carried out at room temperature.

2. TEM micrograph of the coated hybrid

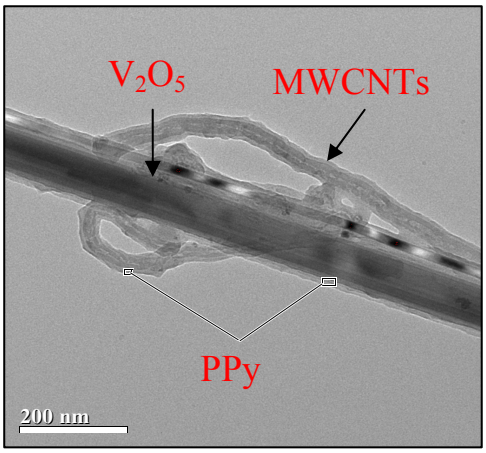

Fig. S1 TEM micrograph of the coated hybrid of V_2O_5 with MWCNTs.

Fig. S1 shows clearly that V_2O_5 nanowires are coated with a thin PPy layer. Of course, MWCNTs are also coated by a thin PPy layer.

3. Change of the charge transfer resistance with charge and discharge process

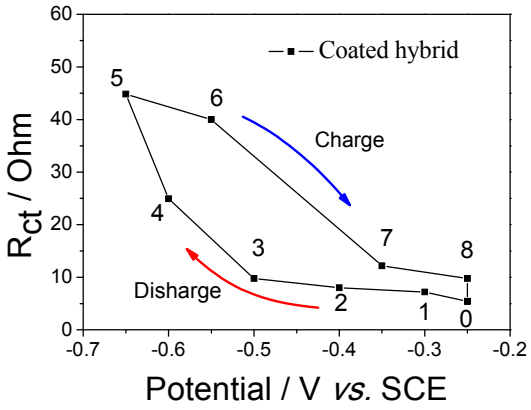

Fig. S2 Change of the charge transfer resistance, R_{ct}, with the charge and discharge process (the potential at each number is the same as that in Fig. 3b).

Agreeing with the CV data from Figure 3a, the values of charge transfer resistance, R_{ct}, determined by EIS against the electrode potential also shows a perfect reversibility. After a full discharge and charge process, the resistance comes almost back to the start.