Electronic Supplementary Material (ESI) for Energy & Environmental Science

Composite of a nonwoven fabric with poly(vinylidene fluoride) as a gel membrane of high safety for lithium ion battery

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Electronic supplement information (ESI):

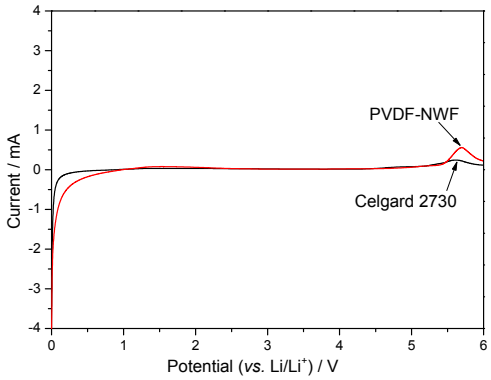

Fig. S1 The linear sweep voltammograms of Celgard 2730 and PVDF-NWF after saturated by $LiFP_6$ electrolytes.

As can be seen from Fig. S1, no current peak is found through the working electrode from open circuit potential to 4.8 V (vs. Li^+/Li) for commercial separator Celgard 2730 saturating with the organic electrolytes. When the open circuit potential is more than 4.8 V, the $LiPF_6$ electrolytes begin to decompose and there is a current peak. The result is consistent with commercial lithium batteries. In the case of the electrochemical stability of the gel PVDF-NWF composite membrane, it is similar to that of Celgard 2730 since the amount of the organic electrolyte is almost the same and contacts directly with the electrodes. That is, the electrochemical window of gel PVDF-NWF membrane is about 4.8 V, which is enough for lithium ion batteries.

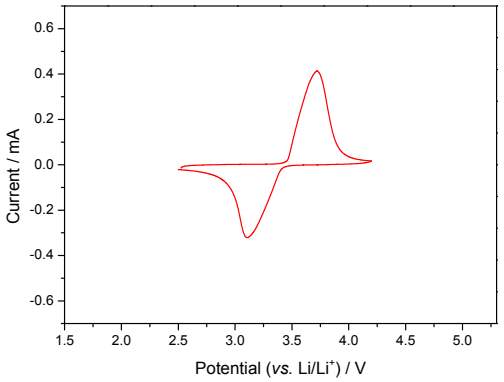

Fig. S2 The cyclic voltammetric curve of $LiFePO_4$/gel PVDF-NWF/Li, scan rate: 0.1 mV s^{-1}.

Fig. S2 shows the cyclic voltammetry curve of $LiFePO_4$/gel PVDF-NWF/Li. As to the redox potentials for the $LiFePO_4$ are at 3.1V and 3.7 V (vs. Li^+/Li), respectively. It is consistent with the intercalation and deintercalation of Li^+ ions into/from the host olivine structure in organic electrolytes.[1]

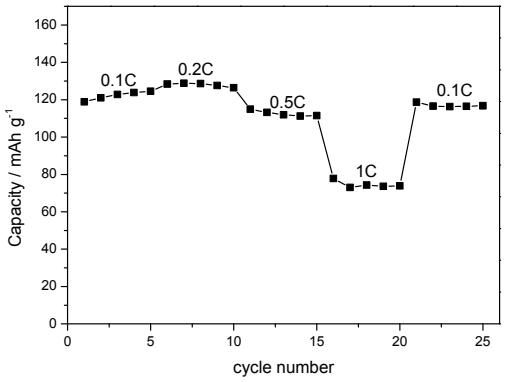

Fig. S3 The rate behaviour of $LiFePO_4$/gel PVDF-NWF/Li at a charge current density of 0.2 C and discharge current density of 0.1 C, 0.2 C, 0.5 C, 1 C and 0.1 C, respectively.

The rate behaviour of $LiFePO_4$/gel PVDF-NWF/Li is shown in Fig. S3. The $LiFePO_4$ was charged with at the current density of 0.2C and discharged at current density of 0.1 C, 0.2 C, 0.5 C and 1 C, respectively. Although the capacity gradually decreases with the rate, the cell exhibits an acceptable rate capability with discharge capacities of 124.5 (0.1 C), 128.8 (0.2 C), 114.9 (0.5 C), and 77.9 mAh g^{-1} (1.0 C) in the systems. When discharged with 0.1C at last, the discharge capacity is recovered to the original value. The given result shows that the composite gel membrane has good rare performance.

Reference

1. D.Y. W. Yu, C. Fietzek, W. Weydanz, K. Donoue, T. Inoue, H. Kurokawa and S. Fujitani, *J. Electrochem. Soc.*, 2007, 154, A253.