Electronic Supplementary Material (ESI) for RSC Advances.

High Efficiency of Bamboo-like Carbon Nanotube on Functionalized Graphite Felt as Electrode in Vanadium Redox Flow Battery

Supporting Information

In order to remove Co nanoparticles, as-prepared B-CNT/TA-GF was washed by H_2SO_4 solution several times and then cleaned by DI water. Then, B-CNT/TA-GF (after the metal removal) was assembled in the cell fixture for the VRFB test, as shown in **Figure S5**. Clearly, B-CNT/TA-GF shows little lower performance after the metal removal but still better than TA-GF. We consider that the decrease of the performance is not only caused by the cobalt removal but also contributed by the breakage of CNT texture due to the acid etching. Therefore, we believe that the imbedded Co is beneficial to the VRFB performance. The capacity of B-CNT/TA-GF without Co-removal process is 938 mAh, which is better than B-CNT/TA-GF with Co-removal process, indicating that the Co nanoparticles further improve the electrochemical performance of our material. B-CNT/TA-GF (after the metal removal) presents good CE, VE, EE, and capacity of 94.6%, 84.9%, 80.3%, and 903 mAh, respectively. The CE, VE, EE and capacity data are summarized in **Table S1**.

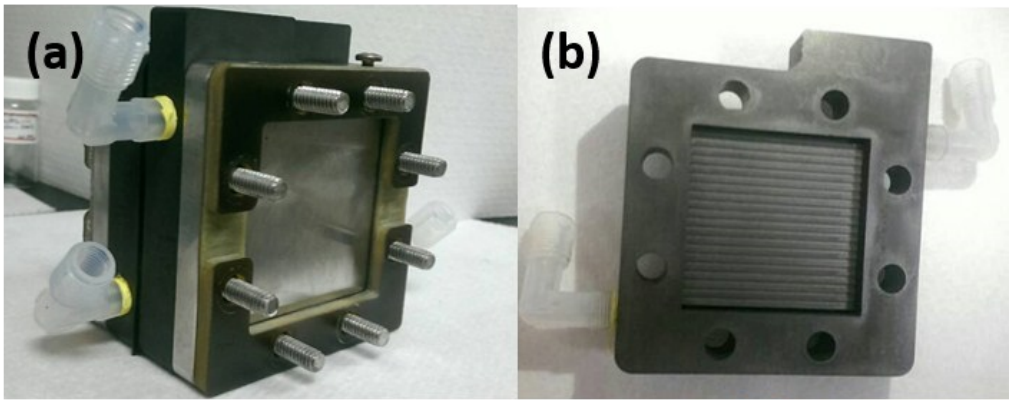

Figure S1. (a) The overview of single cell; (b) the flow field channel design of 25 cm^2 bipolar plates.

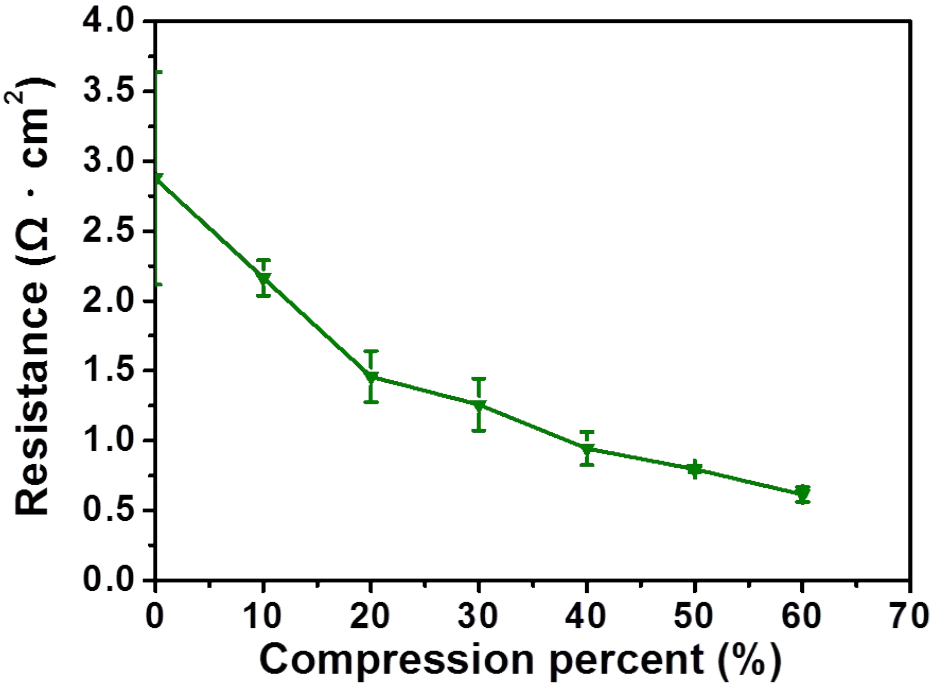

Figure S2. The curve of compression percent vs. resistance for the carbon felt. The compression percent of carbon felt, 20%, is chosen for this study.

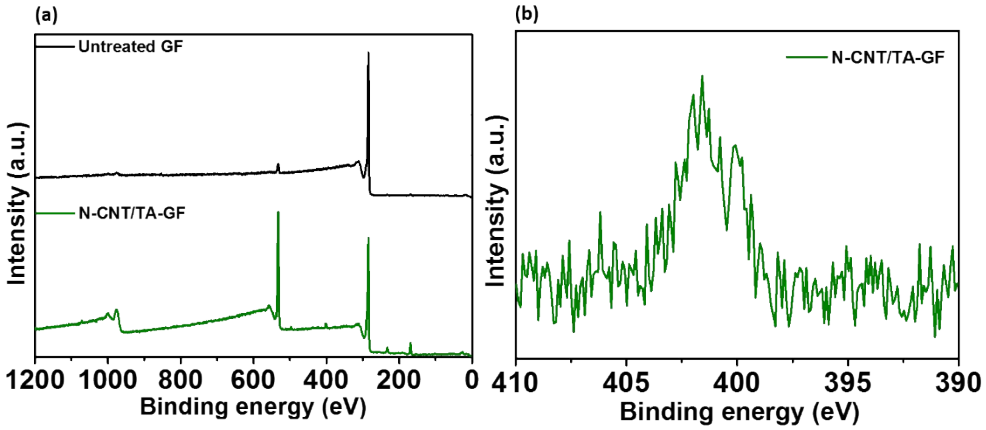

Figure S3. (a) The wide scans of XPS patterns for untreated GF and N-CNT/TA-GF; (b) N1s spectra of N-CNT/TA-GF.

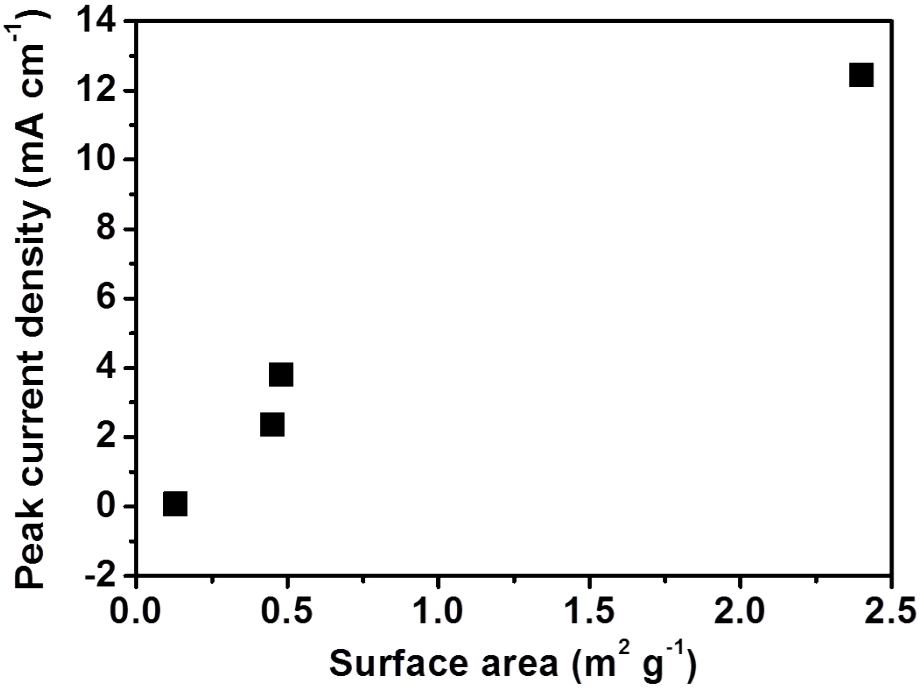

Figure S4. The plot of BET surface areas vs. peak current densities.

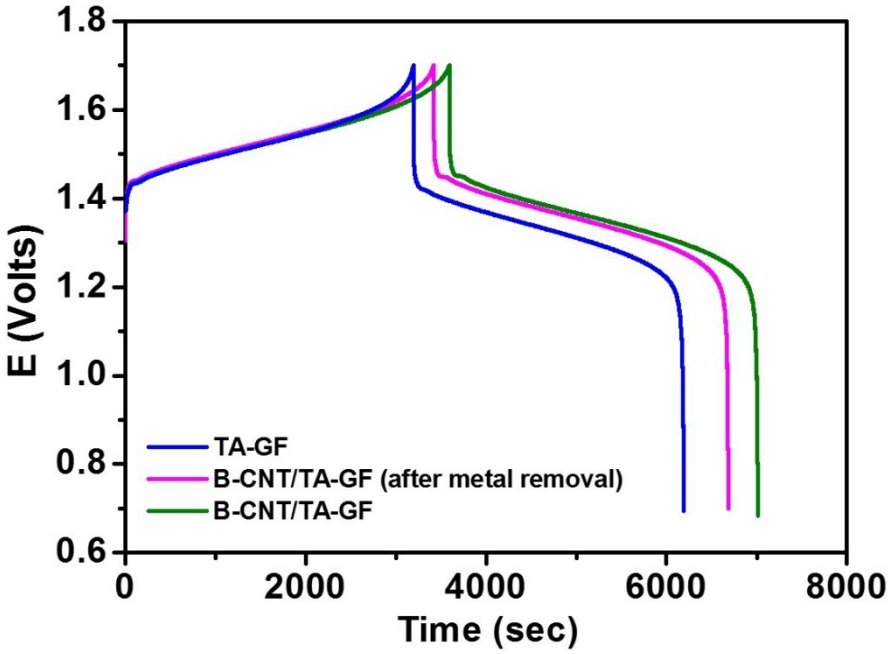

Figure S5: The charge-discharge curves showing the VRFB performances of TA-GF, B-CNT/TA-GF (after metal removal) and B-CNT/TA-GF.

Table S1. The efficiencies of all samples recorded at a current density of 40 mA cm^{-2} in a 25 cm^2 single cell.

Sample	Coulombic efficiency	Voltage efficiency	Energy efficiency	Capacity (mAh)
TA-GF	93.8 %	81.1 %	76.1 %	820
B-CNT/TA-GF (After metal removal)	95.3 %	88.0 %	83.8 %	903
B-CNT/TA-GF	95.0 %	85.3 %	81.0 %	938