Electronic Supplementary Material (ESI) for Nanoscale.

Fiber asymmetric supercapacitor based on FeOOH/PPy on carbon fibers as anode electrode with high volumetric energy density for wearable applications

Gong Xuefei, Li Shaohui, Lee Pooi See*

School of Materials Science and Engineering, Nanyang Technological University, 639798,

Singapore *Email: pslee@ntu.edu.sg

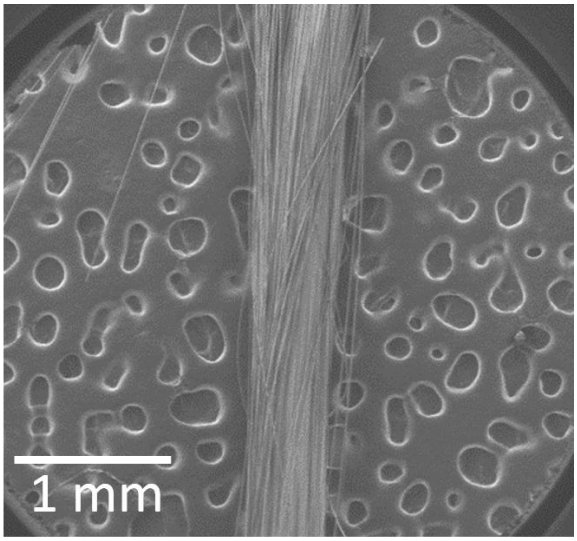

Figure S1. SEM image of a cylindrical thread electrode with active materials.

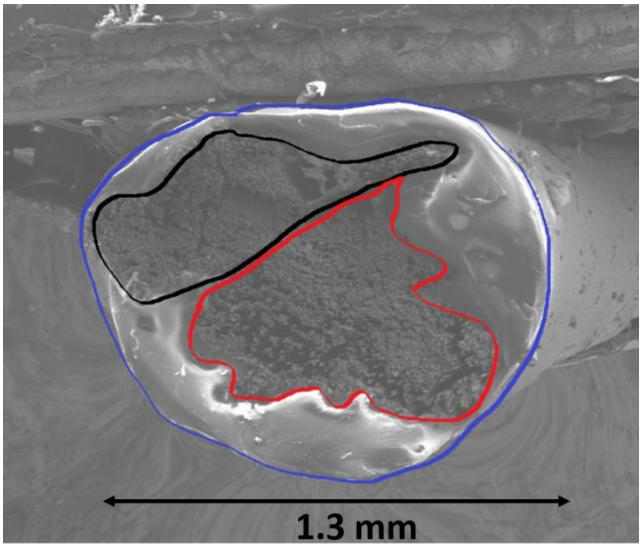

Figure S2. SEM image of an encapsulated fiber supercapacitor. The area enclosed by the red and black line are positive and negative electrode, respectively. The area between blue line and electrodes is the encapsulation layer of Ecoflex.

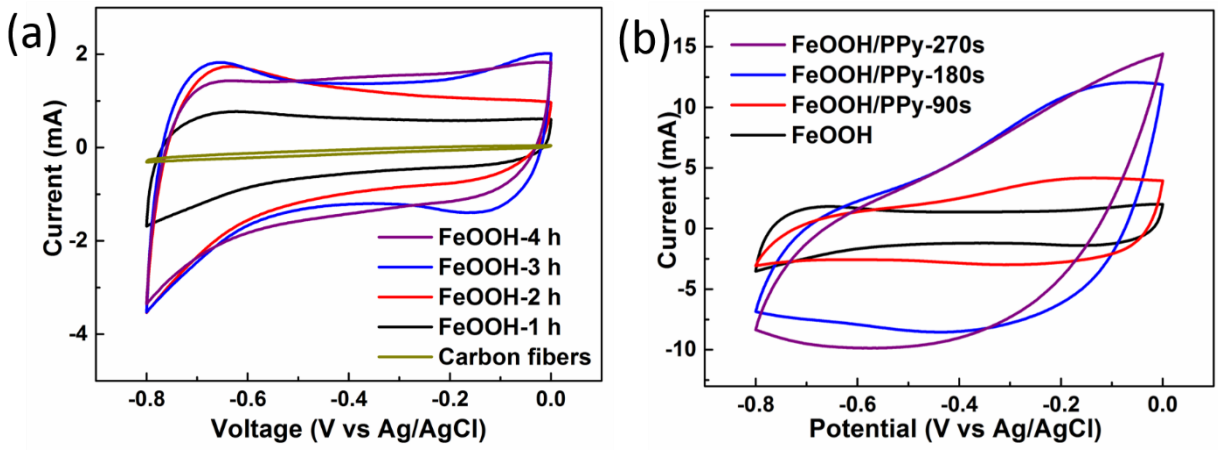

Figure S3. CV curves of (a) FeOOH@CF and (b) FeOOH/PPy@CF with different deposition time at the scan rate of 50 mV/s.

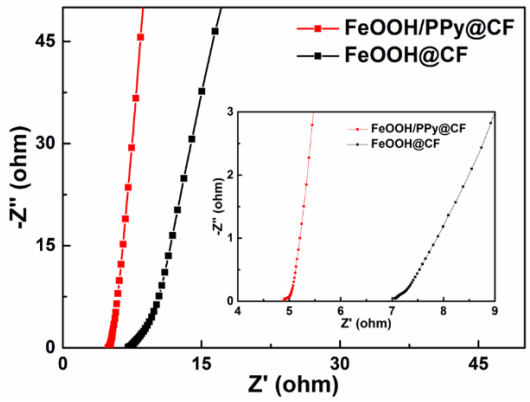

Figure S4: Nyquist plots of FeOOH/PPy@CF and FeOOH@CF electrode.

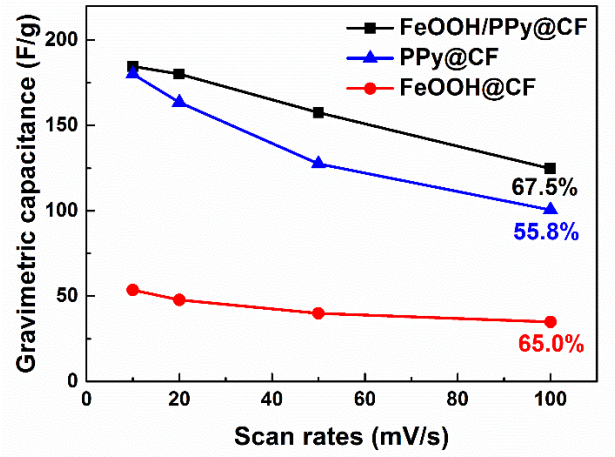

Figure S5: rate capability of FeOOH/PPy@CF, ppy@CF and FeOOH@CF at various scan rates.

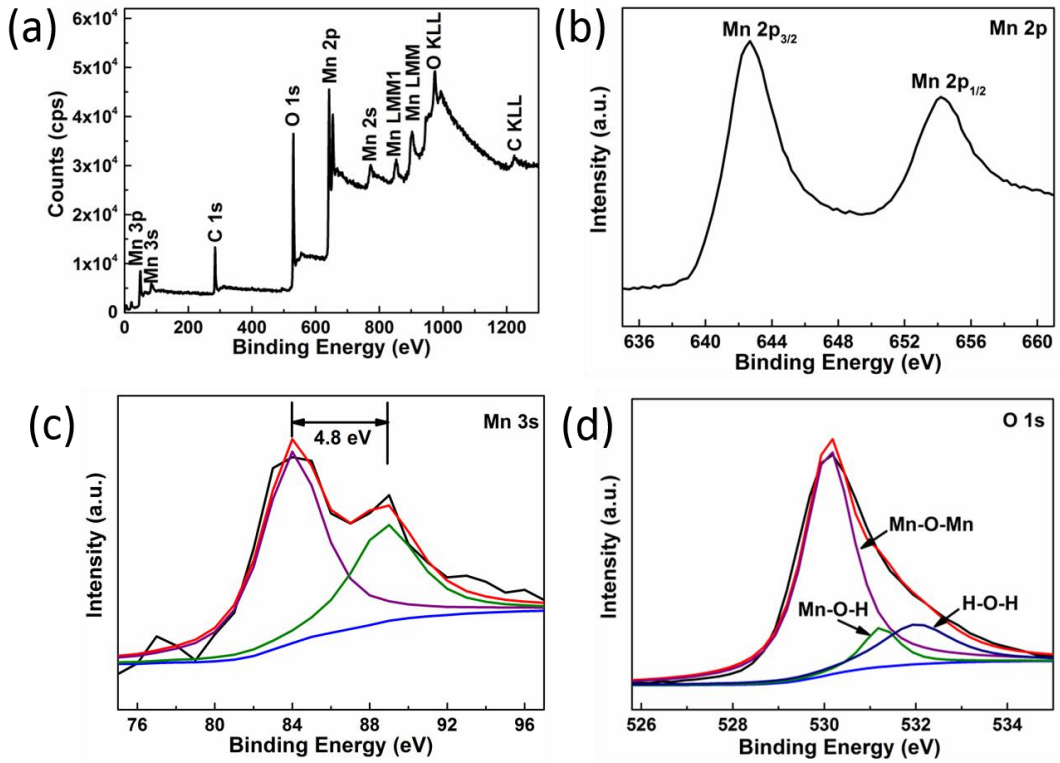

Figure S6. (a) XPS full spectrum, (b) Mn 2p, (c) Mn 3s and (d) O1s of MnO_2 on carbon fibers.

The Mn 2p spectrum shows two distinct peaks centered at 642.3 and 653.9 eV, which could be corresponding to Mn $2p_{3/2}$ and Mn $2p_{1/2}$ and in consistent with the reported values for MnO_2[1-3]. The average Mn oxidation state could be determined from the binding energy width (ΔE) between the separated Mn 3s peaks. We can see the binding energy width was 4.8 eV, suggesting the valence of our prepared sample was +3.9[2, 3]. The band at 530.1 and 531.2 eV from the O 1s spectrum could be assigned to Mn-O-Mn and Mn-O-H bond, respectively[1].

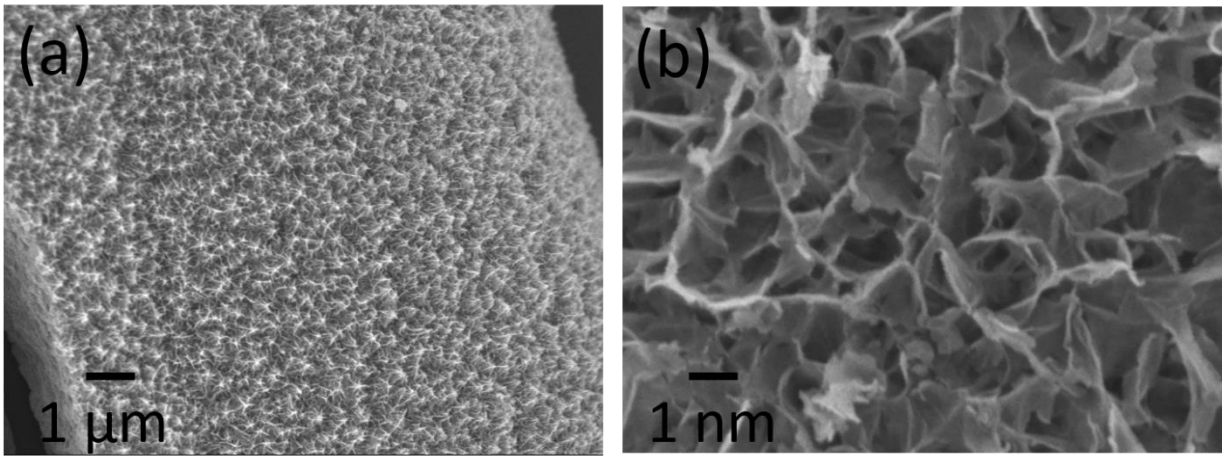

Figure S7. (a) and (b) SEM images of MnO_2 on carbon fibers.

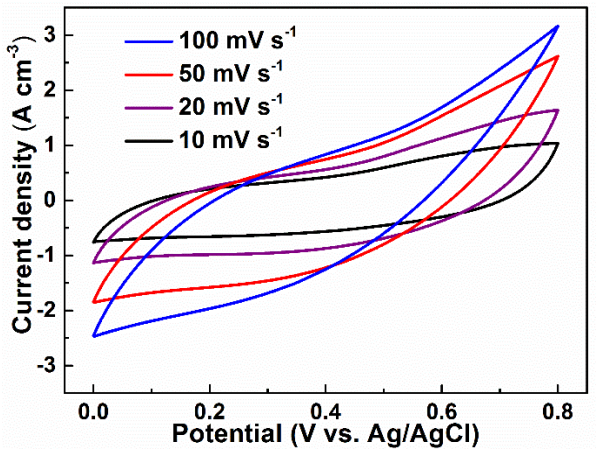

Figure S8. CV curves of MnO_2 on carbon fibers at different scan rates.

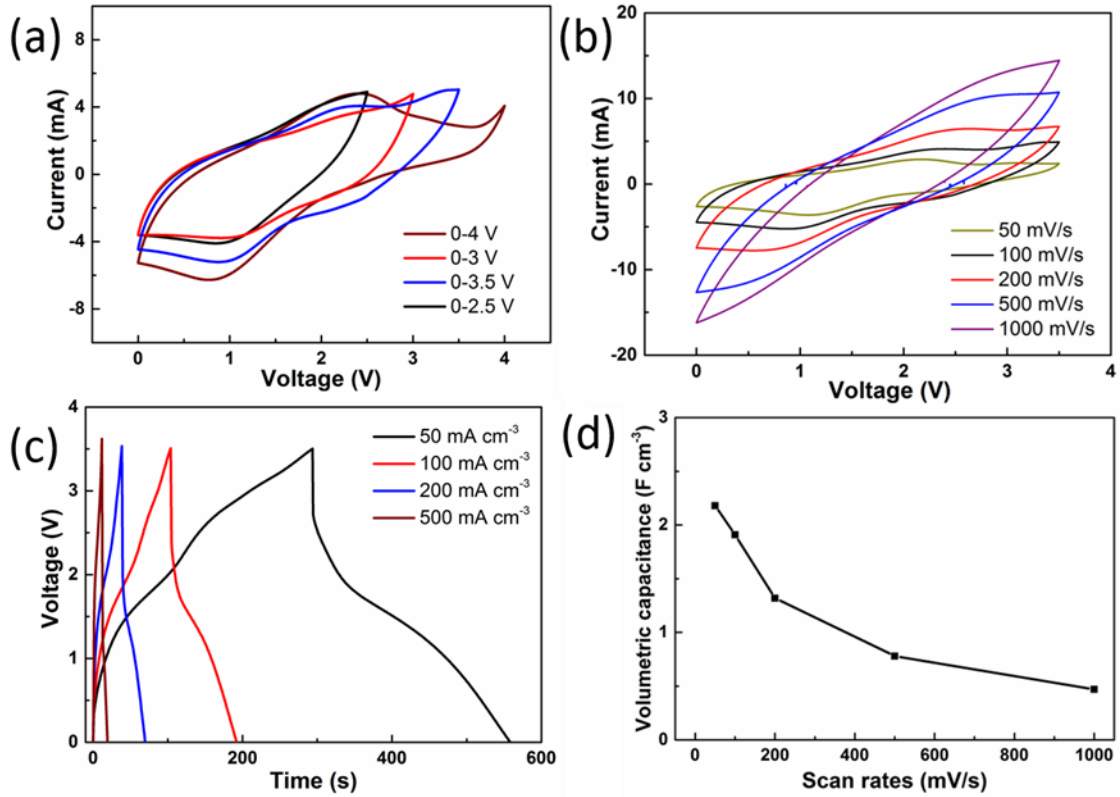

Figure S9. (a) CV curves with various potential range. (b) CV curves with various scan rates. (c) Charging-discharging curves at different current densities. (d) Volumetric capacitances at different scan rates.

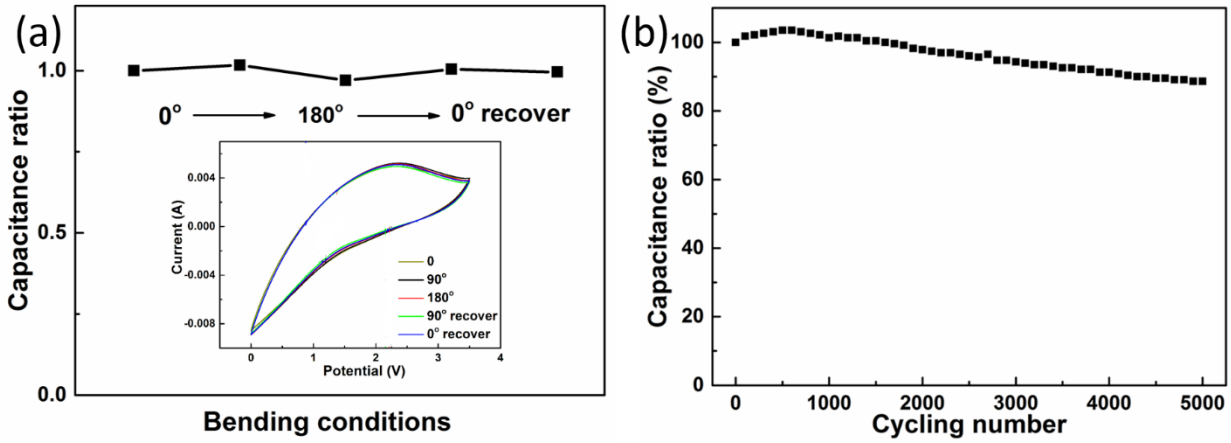

Figure S10. (a) Capacitance ratio of [EMIM][TFSI]/FS supercapacitors woven into a glove at different bending states. CV curves of different bending angles at the scan rate of 500 mV/s (inset). (b) Cycling performance of [EMIM][TFSI]/FS supercapacitors at the scan rate of 500 mV/s.

1. M. Toupin, T. Brousse and D. Bélanger, *Chemistry of Materials*, 2004, **16**, 3184-3190.
2. M. Chigane and M. Ishikawa, *Journal of the Electrochemical Society*, 2000, **147**, 2246-2251.
3. Y. Cheng, S. Lu, H. Zhang, C. V. Varanasi and J. Liu, *Nano letters*, 2012, **12**, 4206-4211.