Supporting Information

A RuO_2 nanoparticle-decorated buckypaper cathode for non-aqueous lithium-air batteries

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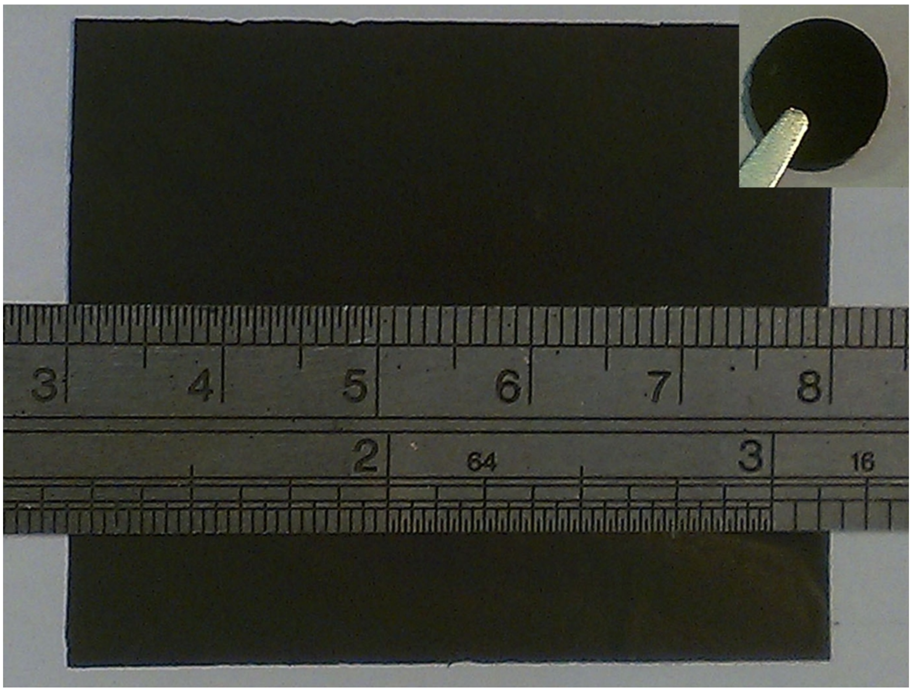


Figure S1 Photograph of the as-received buckypaper, inset shows a disc-like cathode with a diameter of 8 mm.

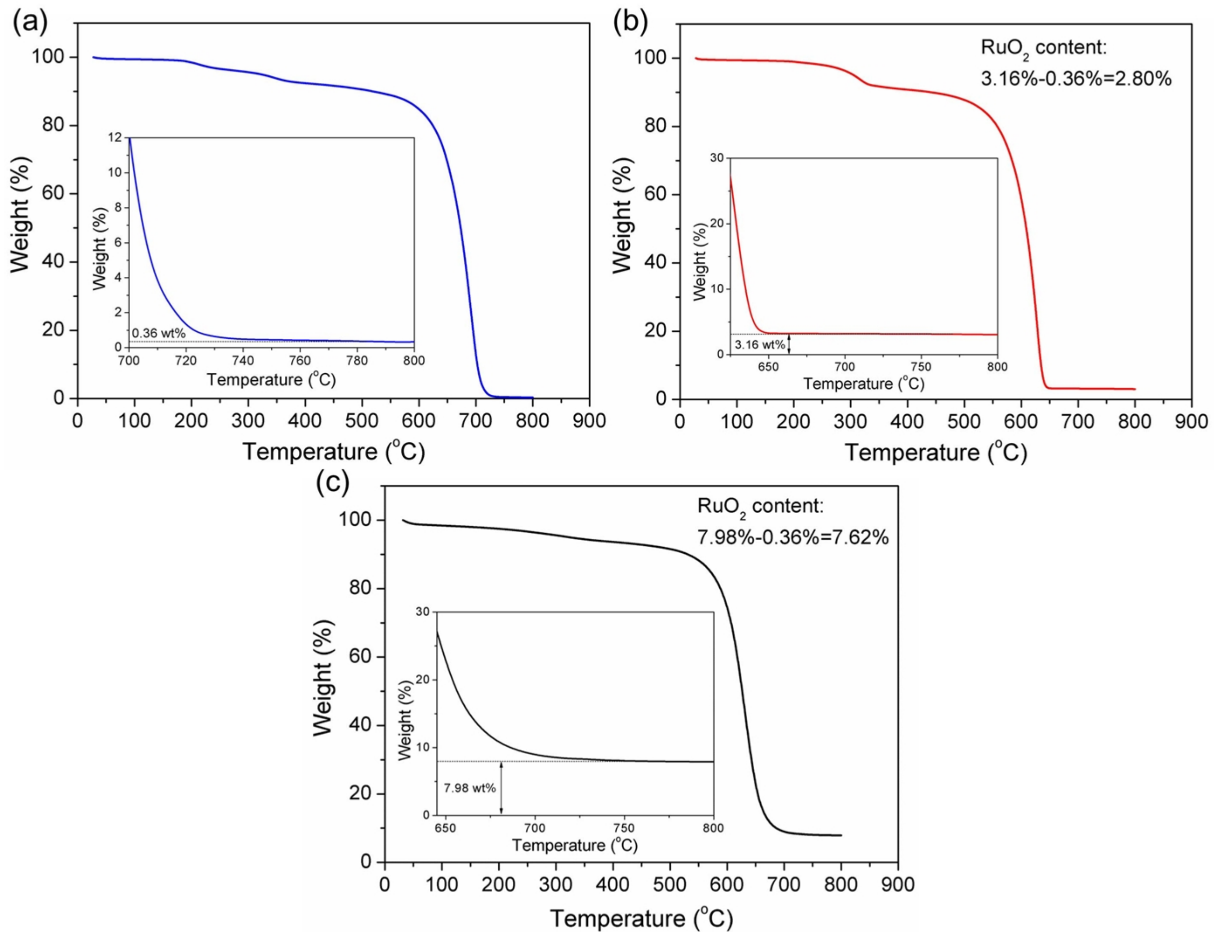


Figure S2 TGA curves measured in air atmosphere from 25 °C to 800 °C at a heating rate of 10 °C per min: (a) Buckypaper and (b-c) RuO_2/Buckypaper cathodes with different RuO_2 loadings.

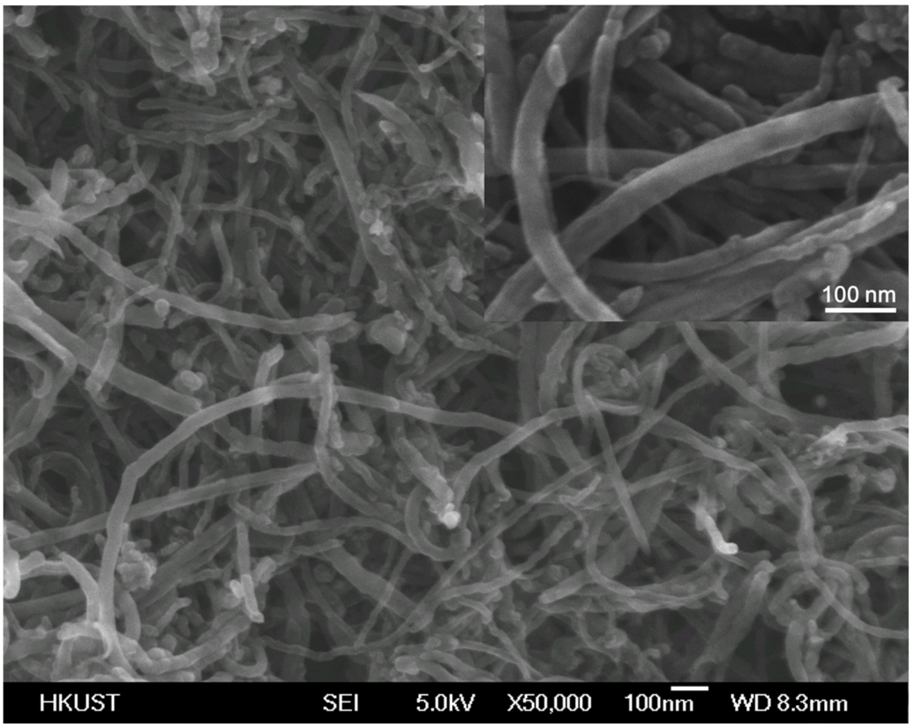


Figure S3 The surface morphology of the Buckypaper cathode, carbon nanotubes with diameters of 20 to 60 nm are weaved to form the porous structure.

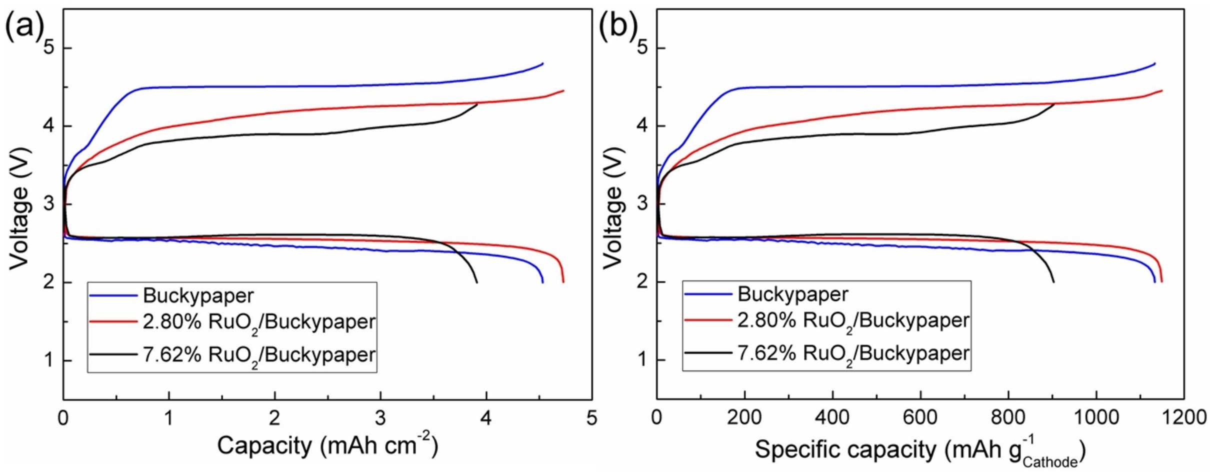


Figure S4 Voltage curves of the cathodes with different RuO_2 loadings at the current density of 0.4 mA cm^{-2} based on (a) the specific area and (b) the specific weight.

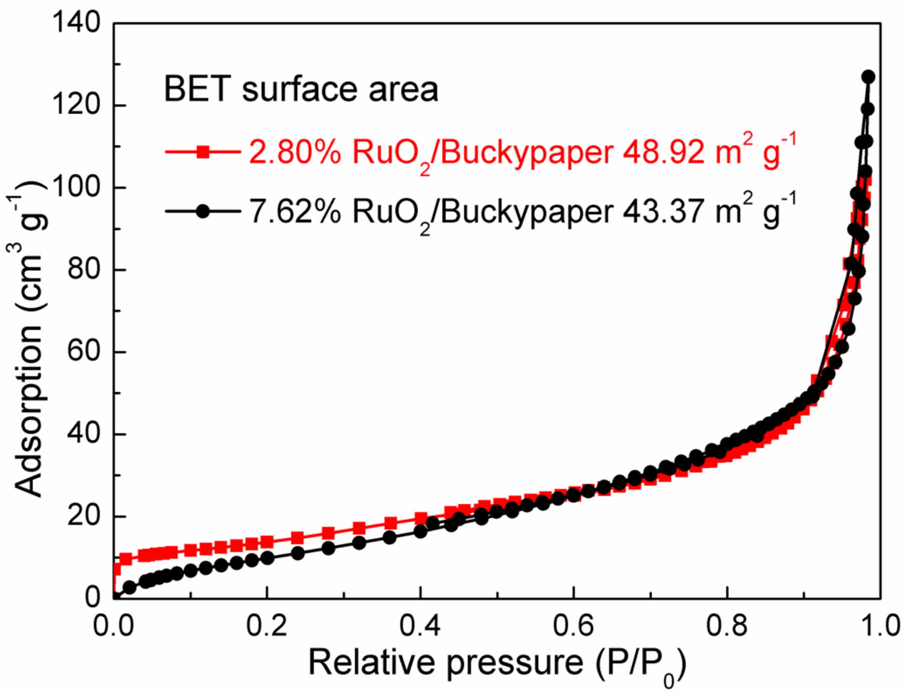


Figure S5 Nitrogen-adsorption-desorption isotherms of the RuO_2/Buckypaper cathodes with different RuO_2 loadings. With the loading of RuO2 increases from 2.80% to 7.62%, the BET surface area decreases from 48.92 m^2 g^{-1} to 43.37 m^2 g^{-1}. The lower surface area at higher RuO_2 loading can be attributed to the dense RuO_2.[1]

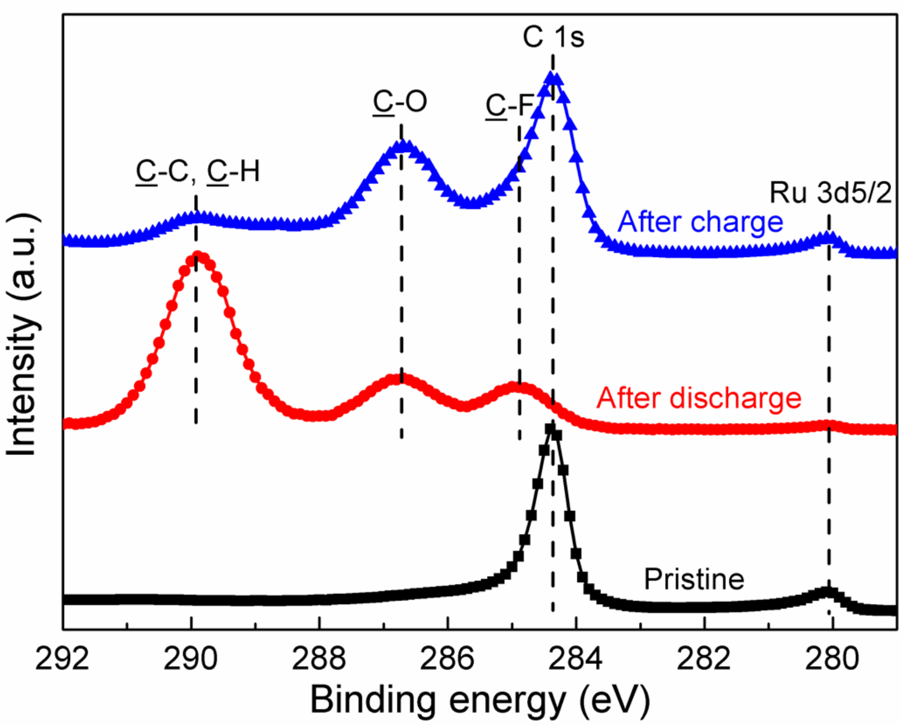
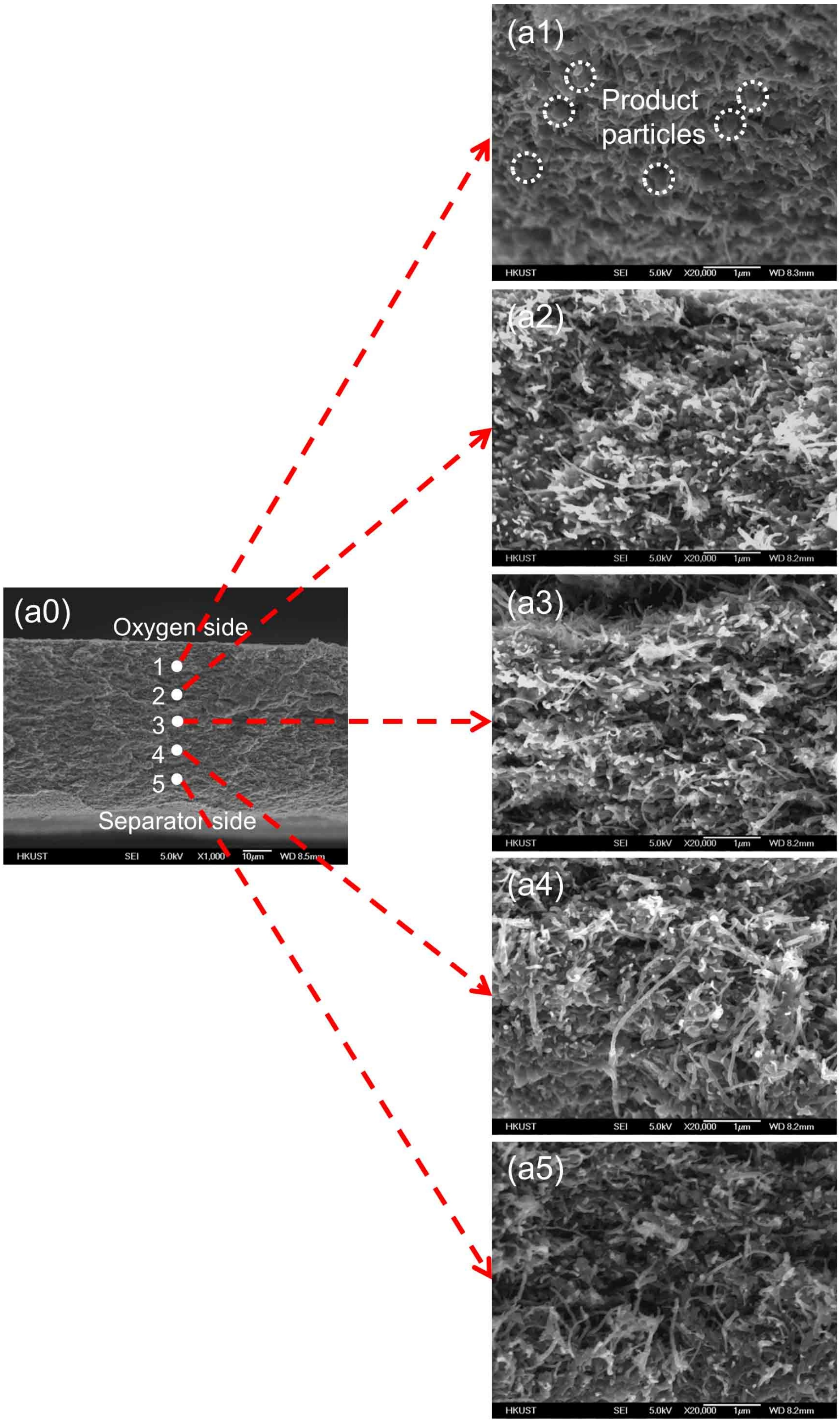


Figure S6 XPS spectra of C 1s and Ru 3d of the RuO_2/Buckypaper cathode after discharge and charge. The Ru 3d signal exists after discharge and charge, indicating that RuO_2 is stable during the cycling process. The C 1s XPS signal shows the existence of side products, which may be caused by the decomposition of electrolyte and carbon.[2] It is worth noting that after discharge, both the Ru 3d and C 1s peaks become weak. Thus, the disappearance of (002) peak related to RuO_2 after discharge process is due to the coverage of Li_2O_2, rather than the reduction of RuO_2.


(a0)
Oxygen side
1
2
3
4
5
Separator side
HKUST SEI 5.0kV X1,000 10μm WD 8.5mm
(a1)
Product
particles
HKUST SEI 5.0kV X20,000 1μm WD 8.3mm
(a2)
HKUST SEI 5.0kV X20,000 1μm WD 8.2mm
(a3)
HKUST SEI 5.0kV X20,000 1μm WD 8.2mm
(a4)
HKUST SEI 5.0kV X20,000 1μm WD 8.2mm
(a5)
HKUST SEI 5.0kV X20,000 1μm WD 8.2mm

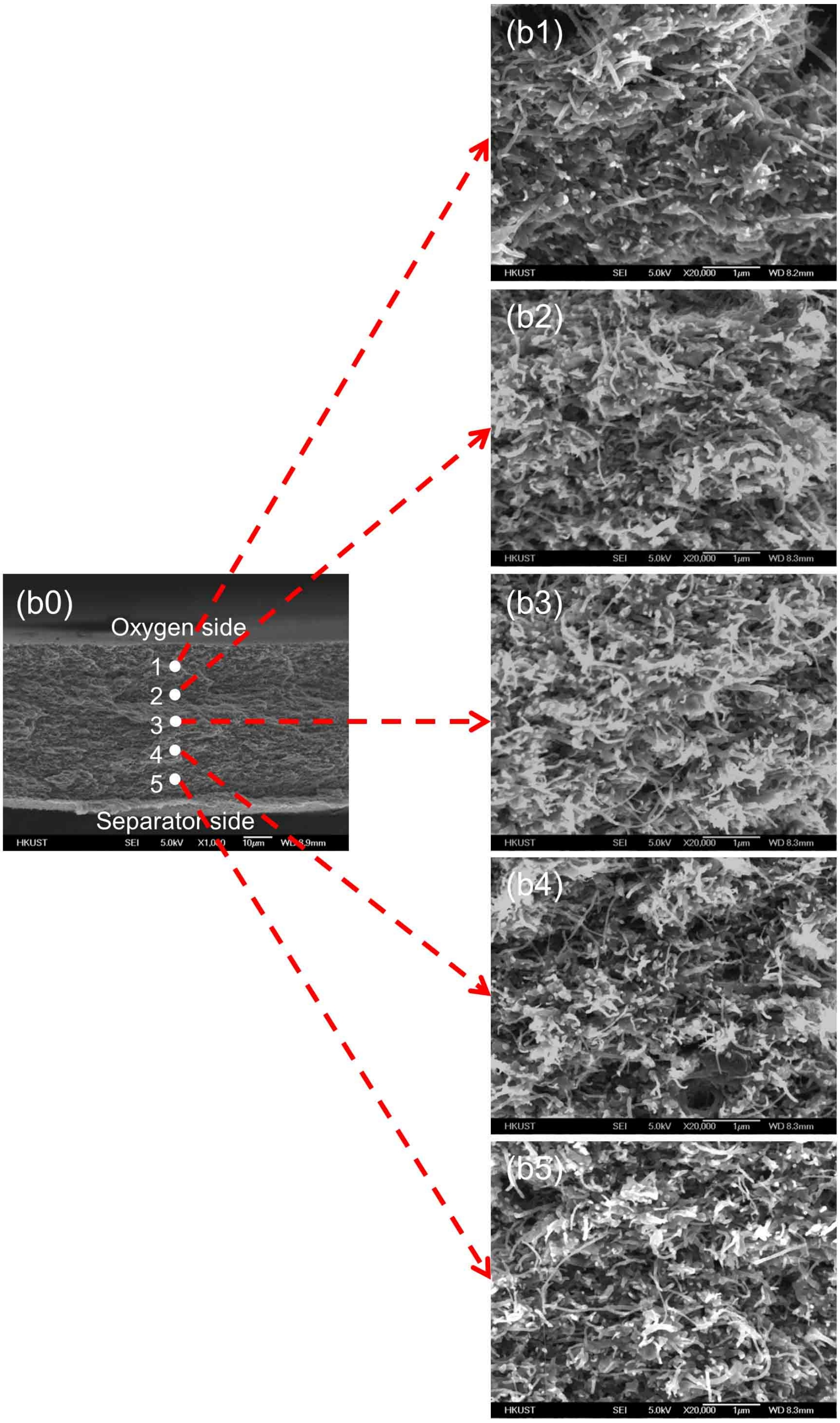


Figure S7 SEM images of the discharged cathode from the oxygen side to the separator side: (a) Buckypaper and (b) RuO_2/Buckypaper. 0 corresponds to the cross-section; 1-5 corresponds to the detected point as marked. For the Buckypaper cathode, particle-like discharge product can be observed at point 1. For the RuO_2/Buckypaper cathode, only film-like discharge product can be observed.

References

[1] Z. Jian, P. Liu, F. Li, P. He, X. Guo, M. Chen and H. Zhou, *Angewandte Chemie-International Edition,* 2014, **53**, 442-446.

[2] F. Li, D. Tang, T. Zhang, K. Liao, P. He, D. Golberg, A. Yamada and H. Zhou, *Advanced Energy Materials,* 2015, 1500249.