Angewandte Chemie
Eine Zeitschrift der Gesellschaft Deutscher Chemiker

Supporting Information

An Ultraflexible Silicon–Oxygen Battery Fiber with High Energy Density

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Supporting Information

Experimental Section

Materials. Lithium wires were obtained from Alfa Aesar. Lithium bis (trifluoromethane sulfonimide) (LiTFSI), lithium nitrate, tetraglyme ($C_{10}H_{22}O_5$, 99%), fluroethylene carbonate and silicon powder (< 50 nm) were purchased from Aladdin Reagent. Trimethylolpropane ethoxylate triacrylate (average M_n of ~428), 2-hydroxy-2-methyl-1-phenyl-1-propanone ($C_6H_5COC(CH_3)_2OH$, 97%), N-methyl-2-pyrrolidinone (NMP), polyacrylic acid and poly(vinylidene fluoride-co-hexafluoropropylene) (average M_n of ~130000) were ordered from Sigma-Aldrich. Polyethylene terephthalate heat shrinkable tube was provided by Suzhou Dasheng Materials Tech Co. Ltd.

Synthesis of aligned carbon nanotube sheet. Spinnable carbon nanotube (CNT) arrays were first synthesized by chemical vapor deposition. Fe (1.5 nm)/Al_2O_3 (5 nm) on a silicon substrate was used as the catalyst. Ethylene with a flowing rate of 90 cm^3/min was used as the carbon source, and a gas mixture of argon (400 cm^3/min) and hydrogen (30 cm^3/min) was used as the carrier gas. The growth occurred at 740 ^oC for 10 min. Finally, the aligned CNT sheets were continually pulled out of the spinnable CNT arrays. The obtained CNTs are multi-walled, and the diameters and lengths are ~12 nm and 200 μm, respectively.

Characterization. The structure was characterized by scanning electron microscopy (SEM, Hitachi FE-SEM S-4800 operated at 1 kV) and X-ray diffraction (Bruker AXS D8). The electrochemical performances were measured with an Arbin electrochemical station (MSTATS-5V/10 mA/16Ch). The photographs were taken by a camera (Nikon, J1). The bending cyclic stability measurements of the silicon-oxygen battery (SOB) fibers were performed at HY-0350 tensile machine, Shanghai Hengyi Testing Instruments Co. LTD. For a typical bending test, two ends of the SOB with length of 8 cm were first fixed in tensile machine and then bent into a circle at speed of 10 cm/min with the distance between two ends as 1 cm.

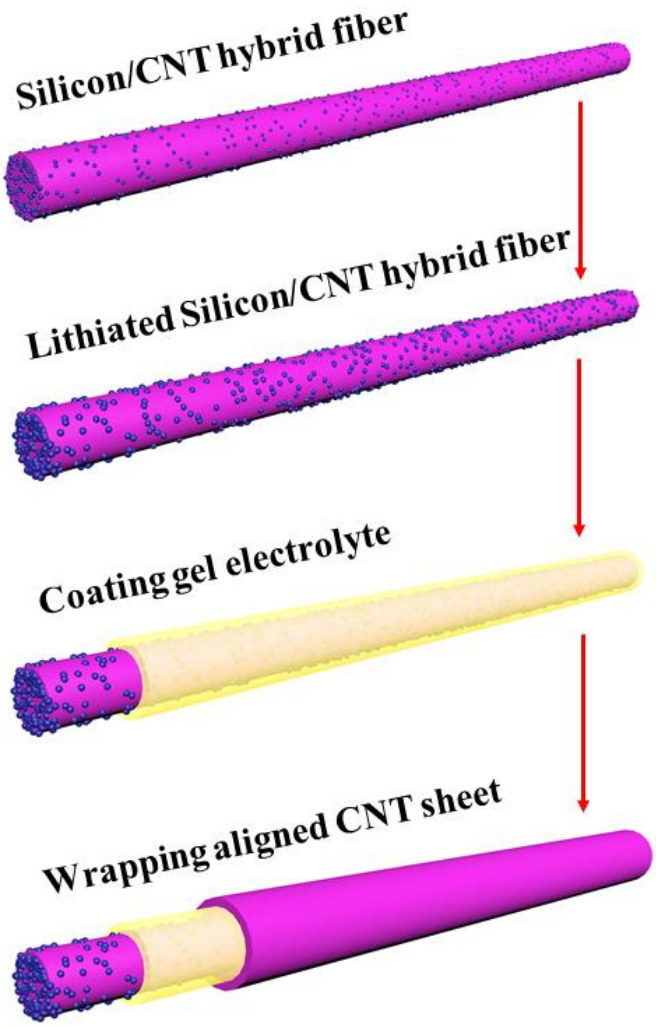

Figure S1. Schematic illustration to the fabrication of the SOB fiber.

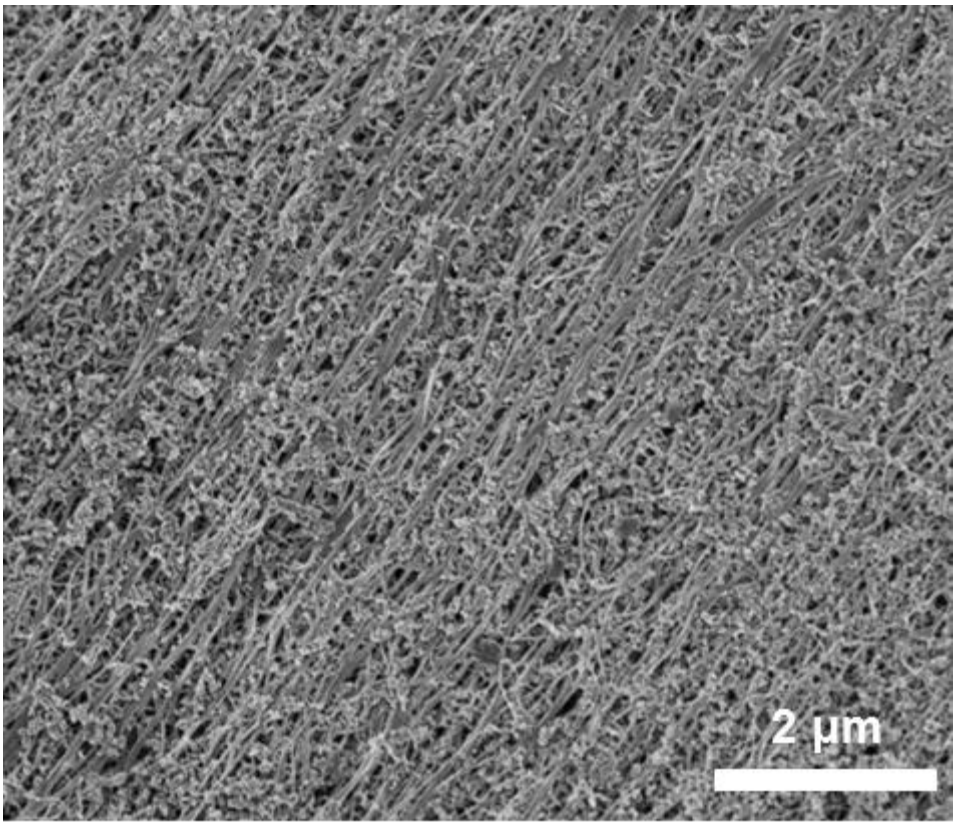

Figure S2. Scanning electron microscopy (SEM) image of silicon/CNT hybrid fiber.

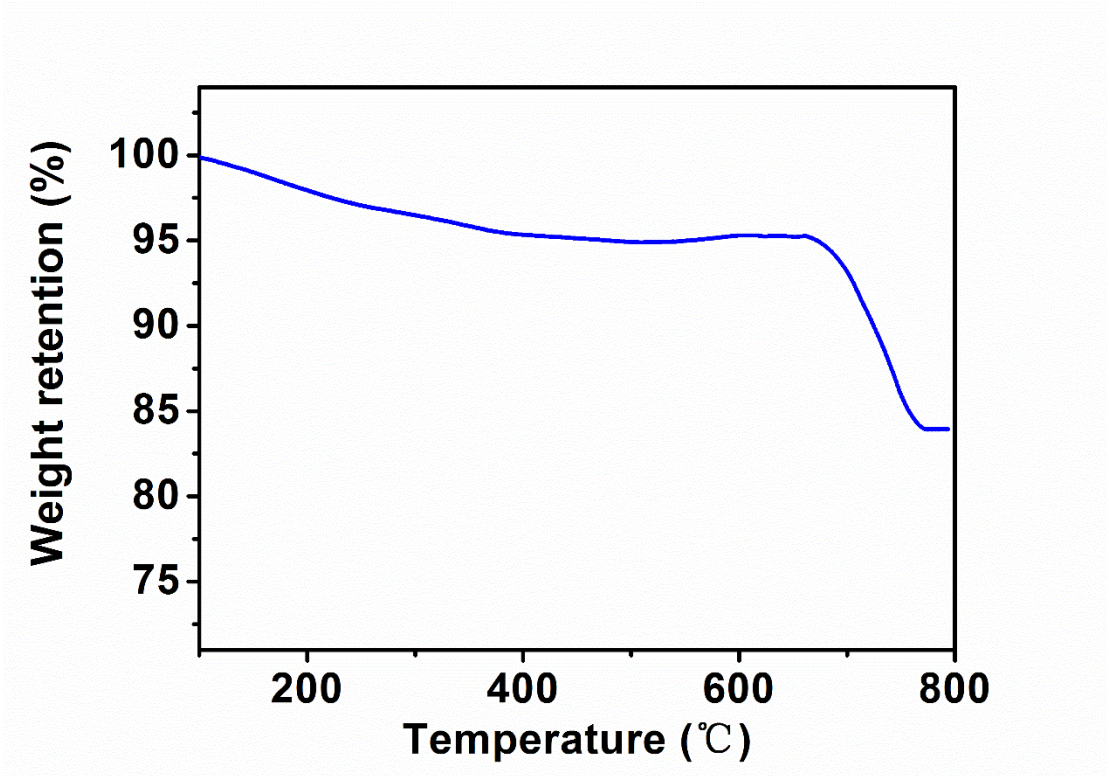

Figure S3. Thermogravimetric analysis of silicon/CNT hybrid fiber in air.

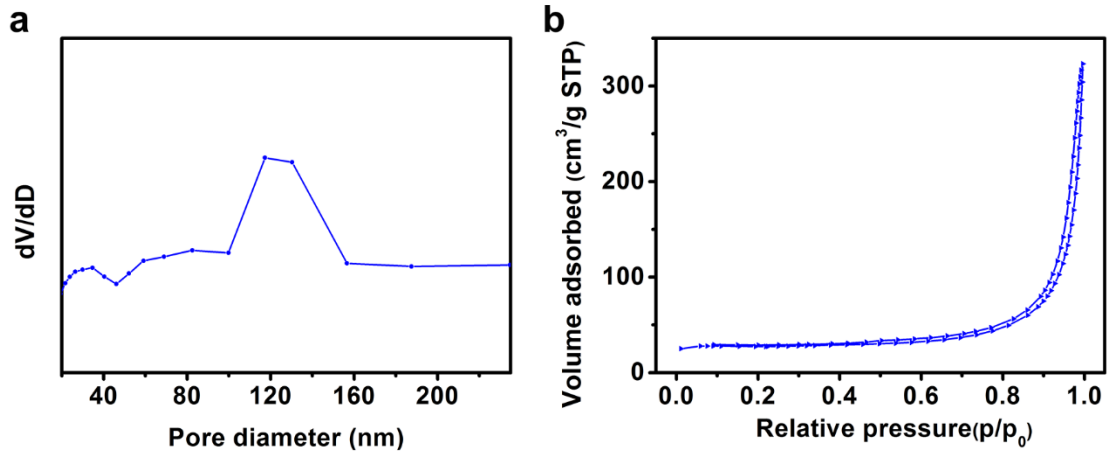

Figure S4. a) Pore size distribution of the CNT material. b) Nitrogen sorption isotherms of the CNT material.

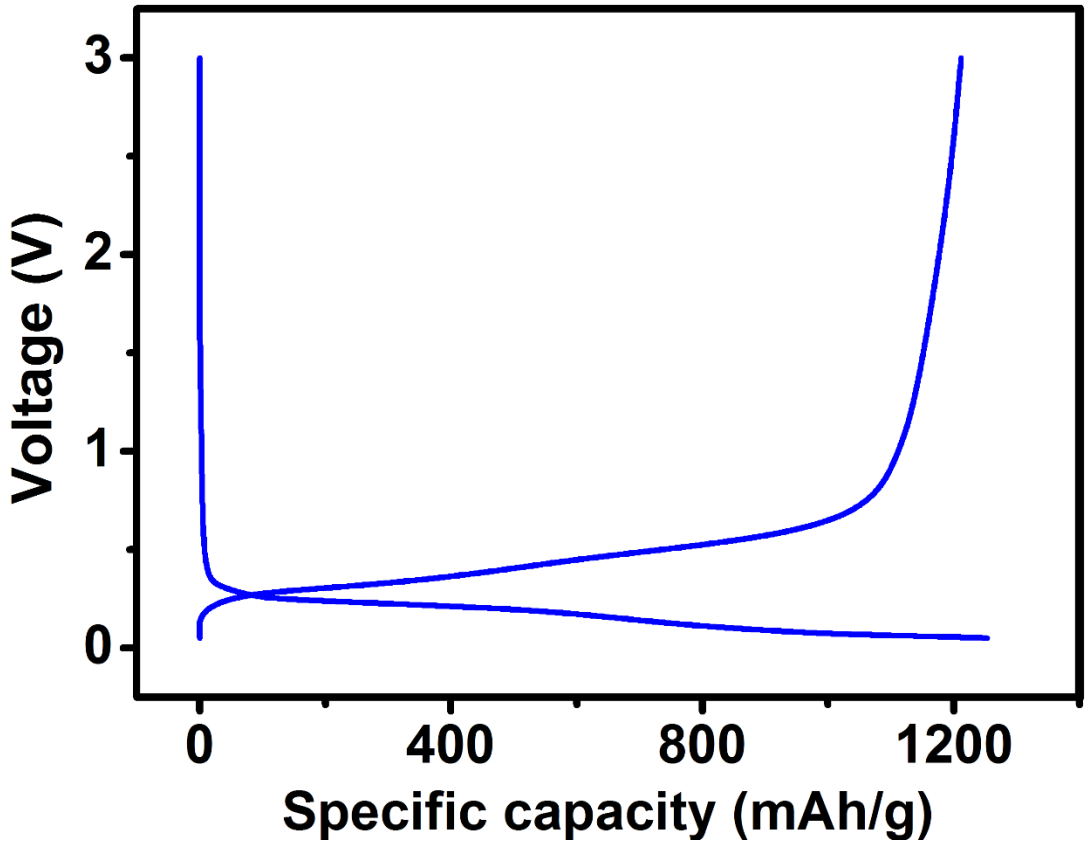

Figure S5. Charge and discharge curves of the lithiated silicon/CNT hybrid fiber anode at the current of 0.1 mA.

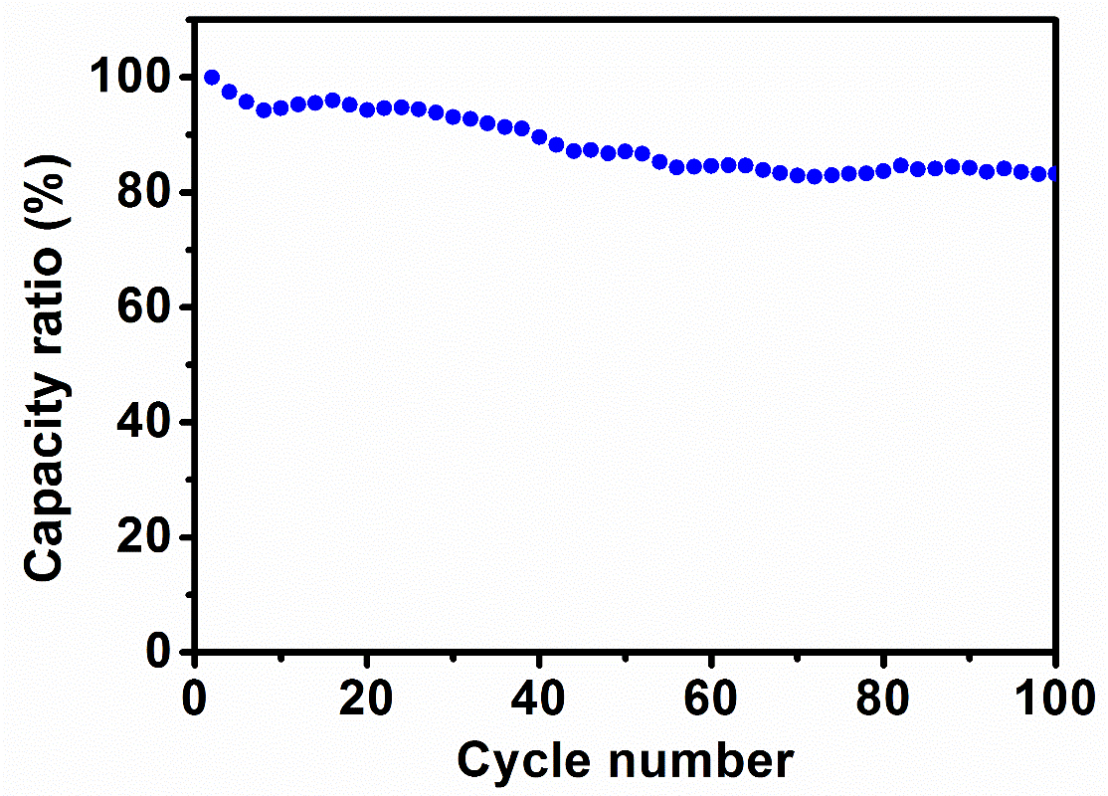

Figure S6. The cycling performance of lithiated silicon/CNT hybrid fiber anode at the current of 0.1 mA.

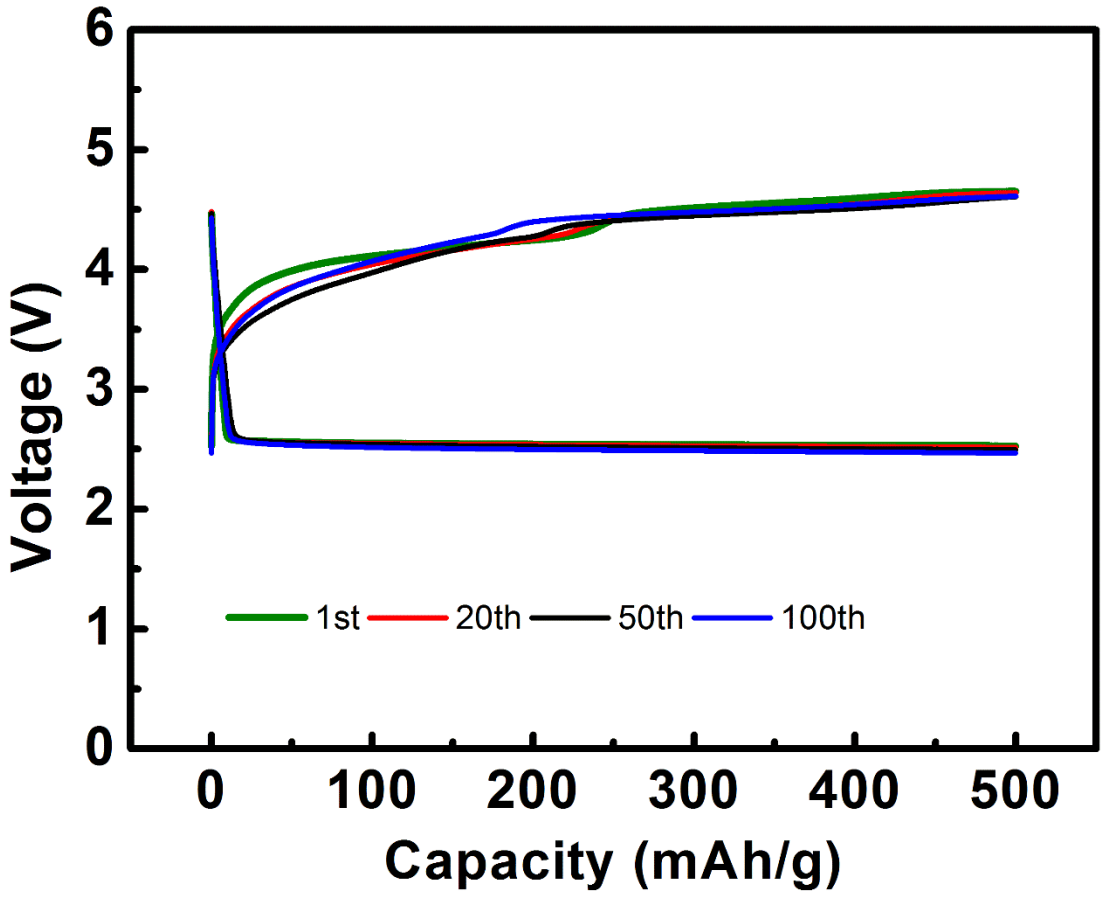

Figure S7. Charge and discharge curves of the CNT cathode at the current of 0.1 mA.

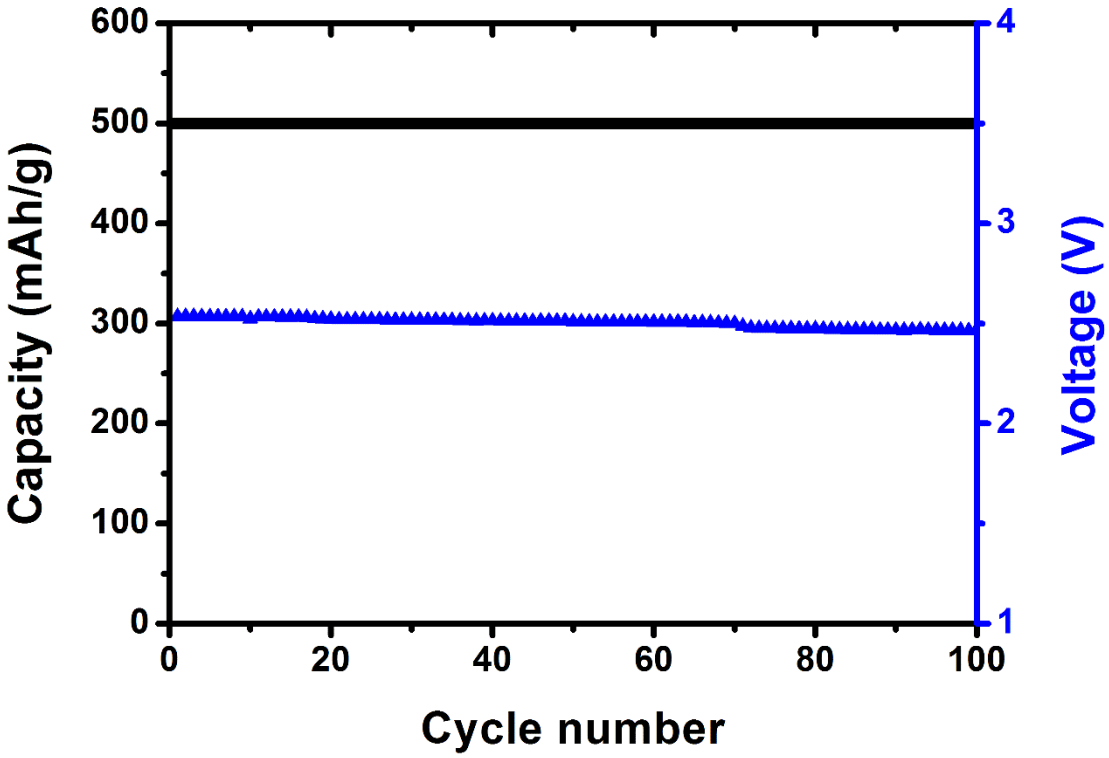

Figure S8. The cycling performance of CNT cathode at the current of 0.1 mA.

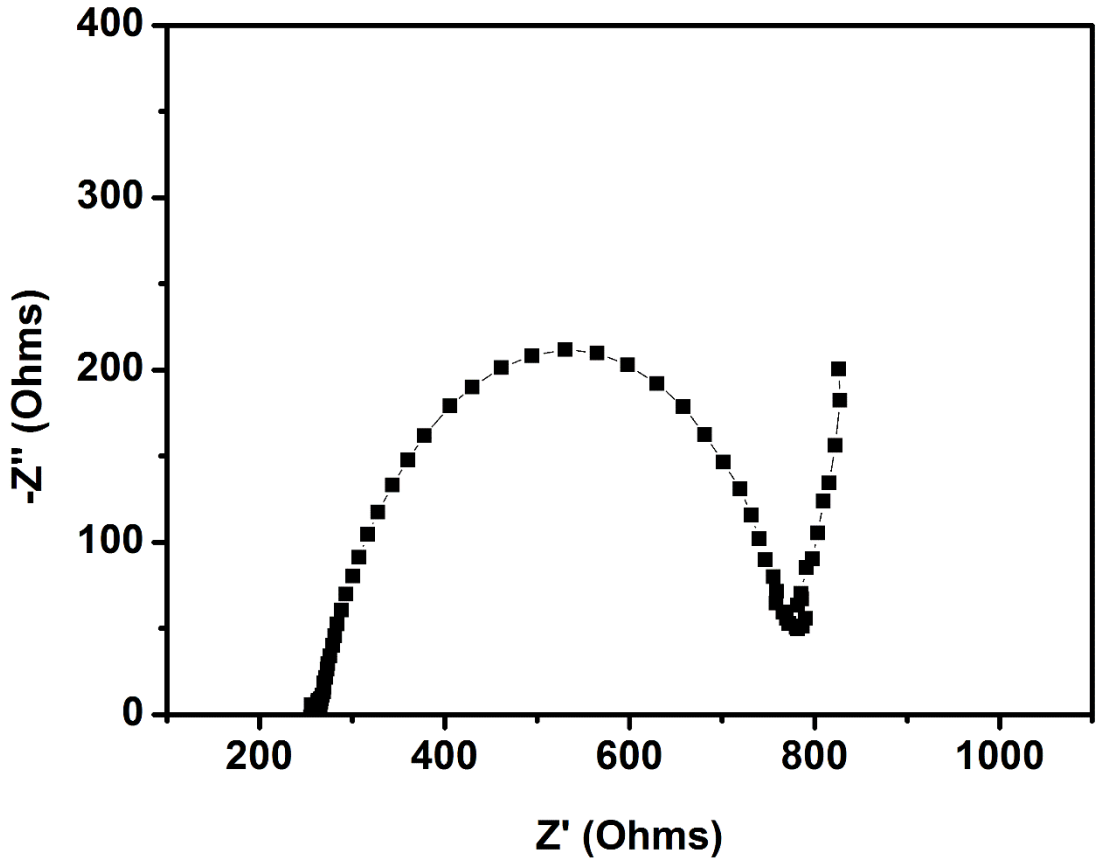

Figure S9. Time-dependence impedance spectra of the SOB fiber battery with a length of 8 cm.