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Supplementary Information

Lignosulphonate-cellulose Derived Porous Activated Carbon for Supercapacitor Electrode

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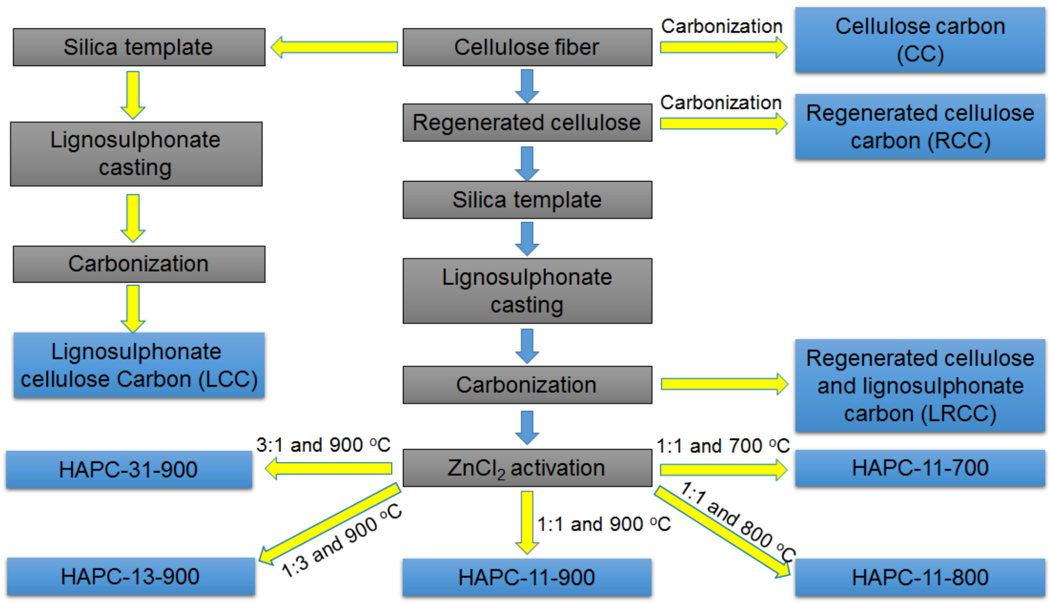

Figure S1: Flow chart of the preparation process of the carbon samples.

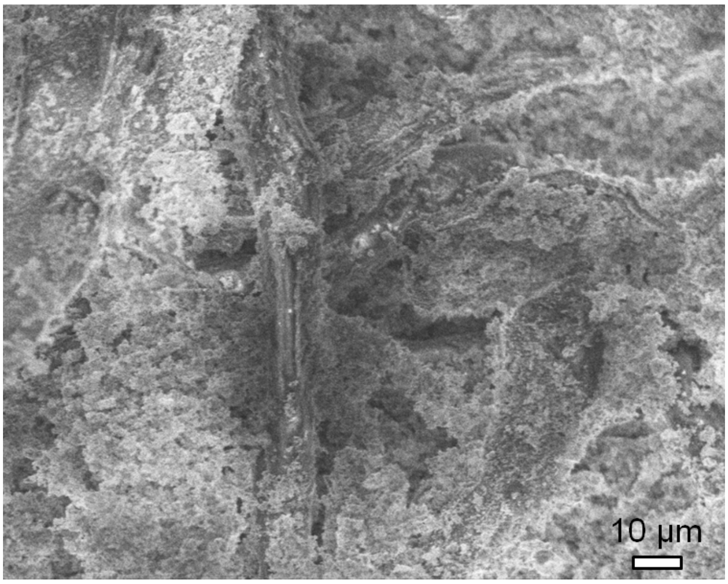

Figure S2. SEM observation of the composite containing silica particles and cellulose.

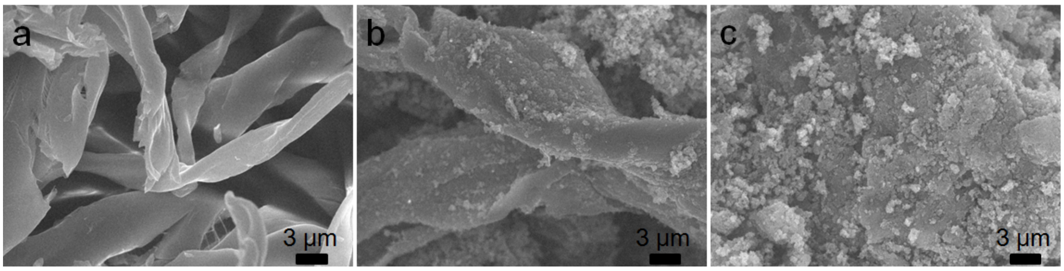

Figure S3. SEM images of (a) cellulose carbon (CC), (b) lignosulphonate/cellulose carbon (LCC) and (c) lignosulphonate/regenerated cellulose (LRCC).

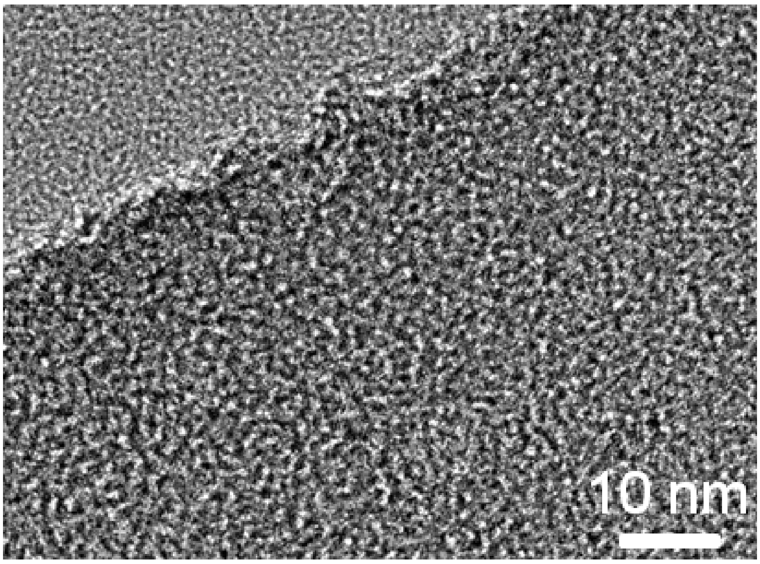

Figure S4. TEM image of LRCC before chemical activation.

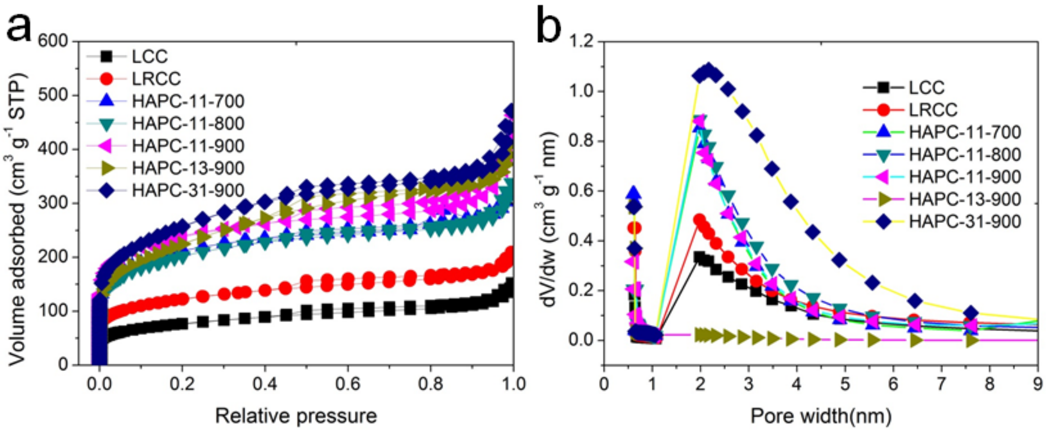

Figure S5. The nitrogen adsorption/desorption isotherm curves (a) and pore distribution (b) of the as-prepared carbon samples.

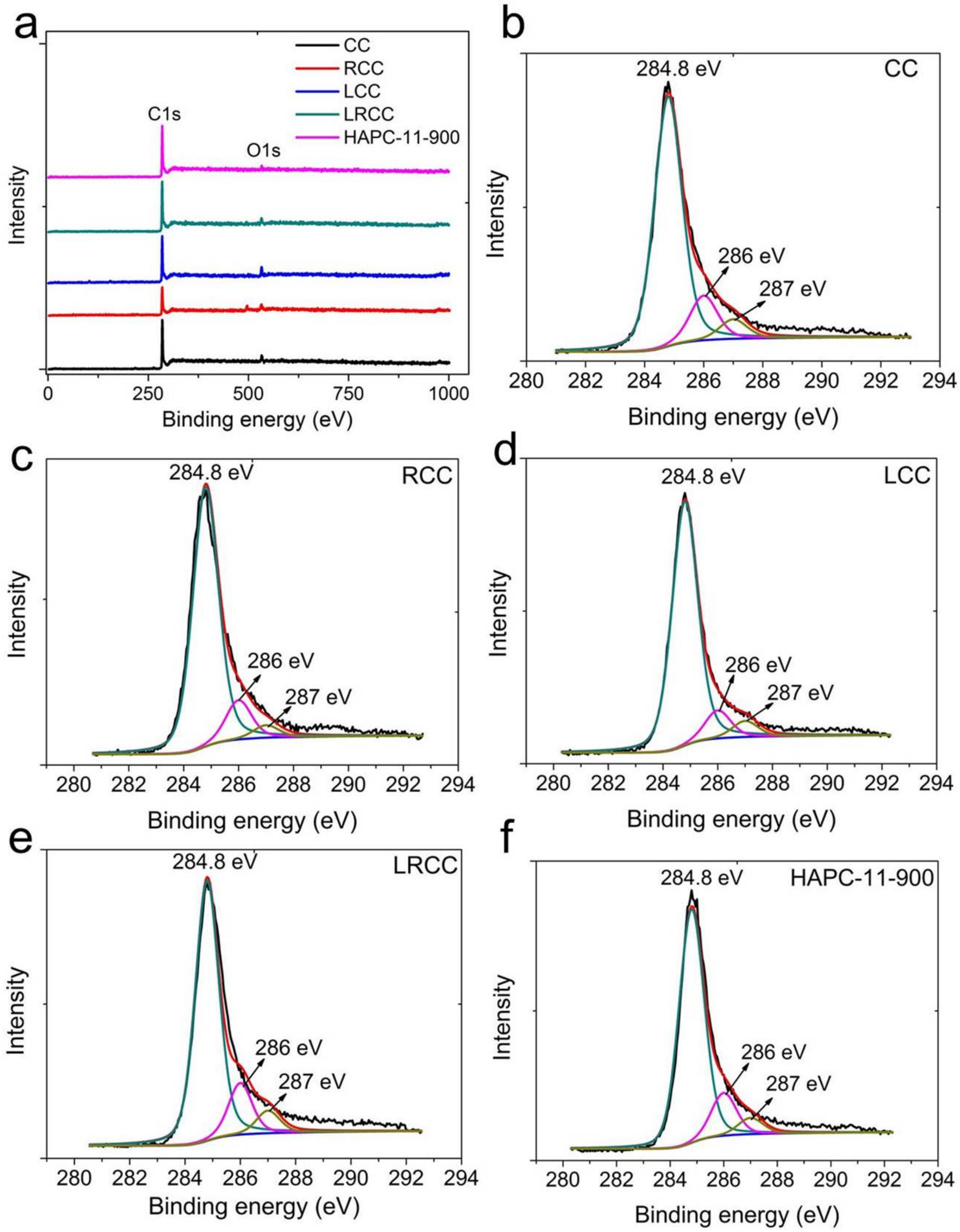

Figure S6. (a) XPS survey scanning of CC, RCC, LCC, LRCC and HAPC-11-900 and XPS C1s elementary scanning of (b) CC, (c) RCC, (d) LCC, (e) LRCC and (f) HAPC-11-900, respectively. The oxygen content of CC, RCC, LCC, LRCC and HAPC-11-900 is about 20.5 at%, 16.3 at%, 13.9 at%, 21.1 at% and 19.5 at%, respectively.

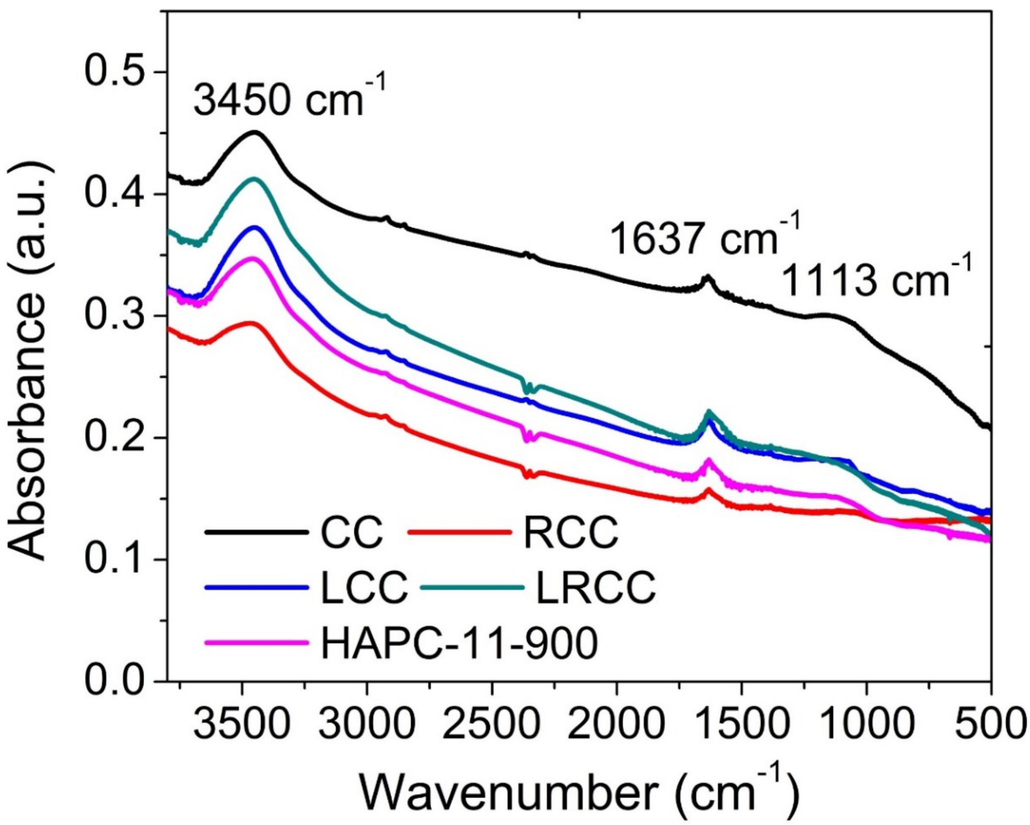

Figure S7. FTIR spectra of CC, RCC, LCC, LRCC and HAPC-11-900. The band centered at 3450 cm^{-1} can be assigned to the vibration of the –OH group. The FTIR bands at around 1637 cm^{-1} can be indexed to the benzene ring skeletal vibration.

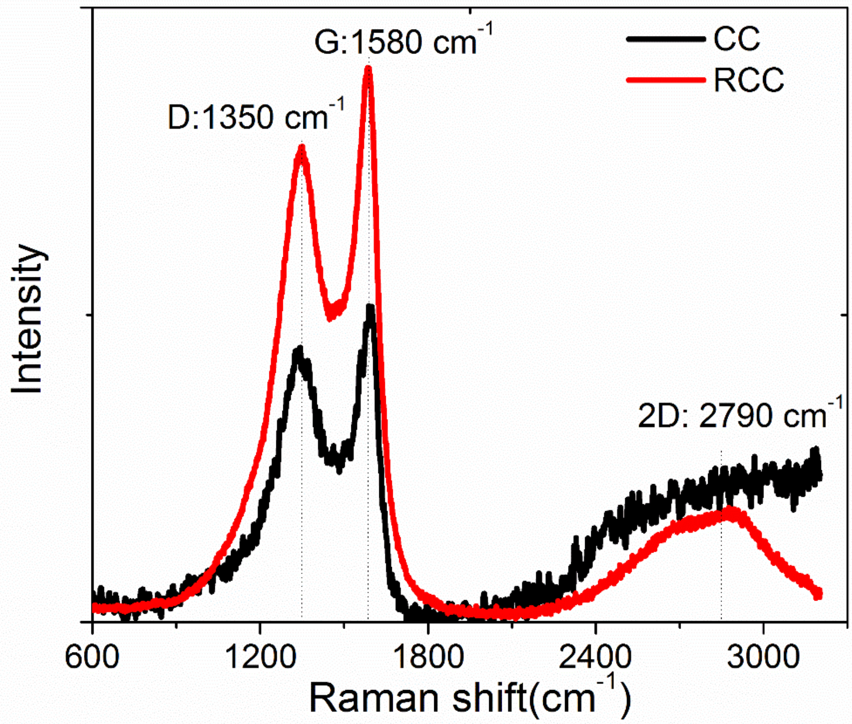

Figure S8. Raman spectra of CC and RCC. The intensity ratio of I_D/I_G of CC and RCC is calculated to be 0.95 and 0.87.

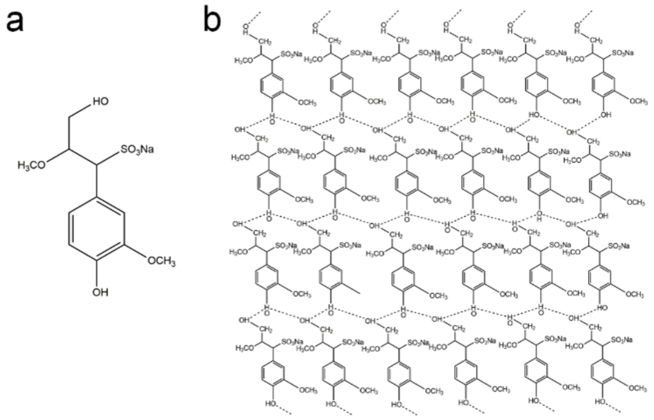

Figure S9. (a) Chemical structure of sodium lignosulphonate and the possible crosslinked lignosulphonate network. The dash line refers to the hydrogen bond.

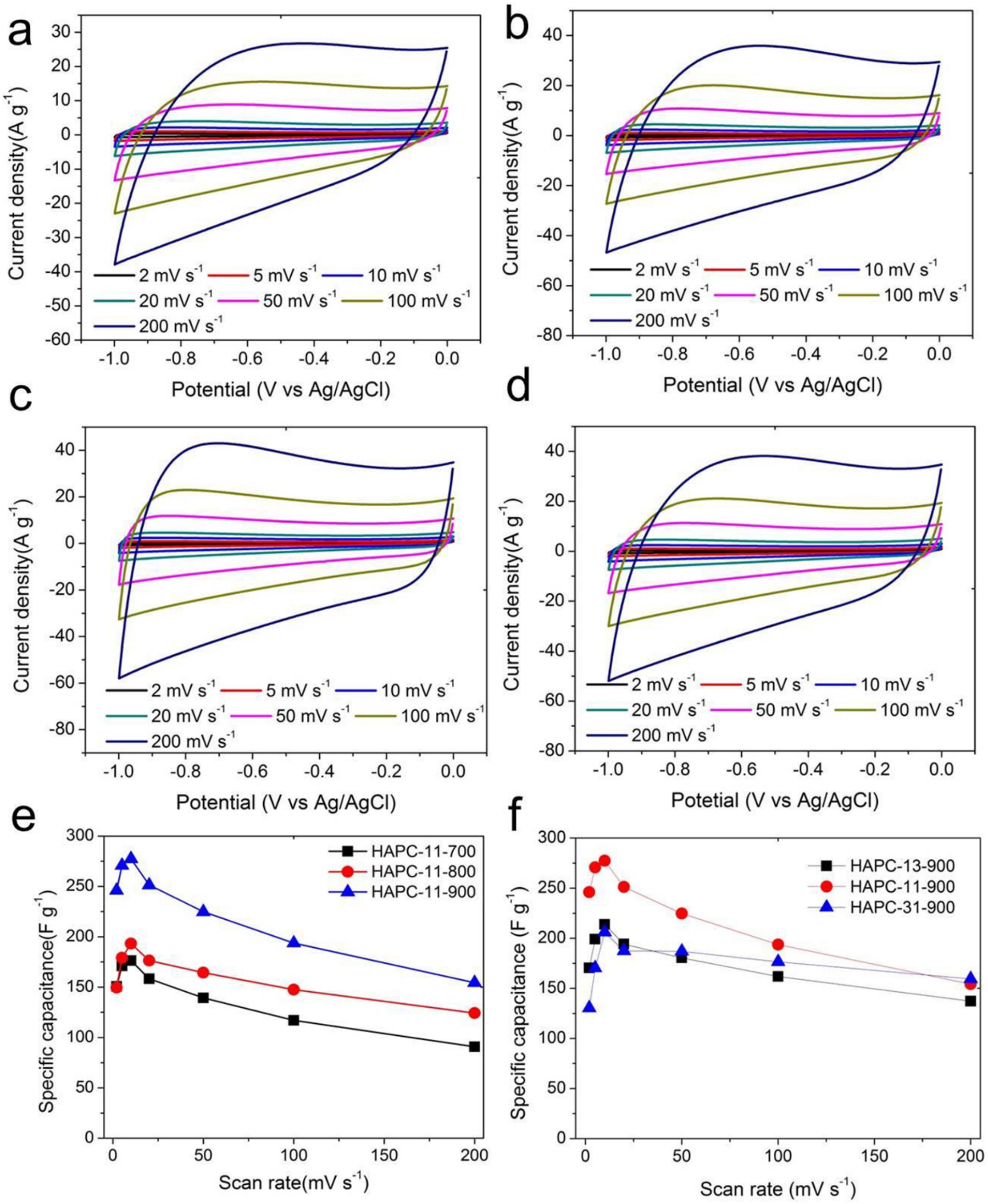

Figure S10. Cyclic voltammetry curves obtained from the various carbon electrodes using the three-electrode configuration including (a) HAPC-11-700, (B) HAPC-11-800, (c) HAPC-13-900 and (d) HAPC-31-900. (e) Specific capacitance as a function of the scan rate for the samples activated at different activation temperatures in a mass ratio of $ZnCl_2$ to carbon at 1:1, and (f) specific capacitance as a function of the scan rate for the samples activated at 900 ^{o}C in different mass ratios of $ZnCl_2$ to carbon.

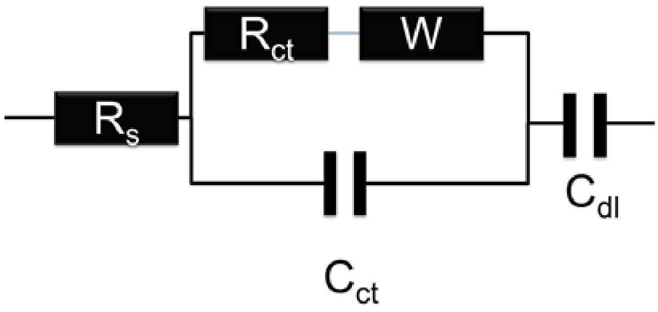

Figure S11. Equivalent circuit representing the impedance spectra of the HAPC-11-900 symmetric cell. The equivalent circuit contains an ohmic resistance R_s, which includes the contact resistance of leads, the bulk solution resistance and the sheet resistance of the carbon film, a charge transfer capacitance C_{ct} which is in parallel with the charge transfer resistance R_{ct}, and a Warburg element W attributed to the diffusion of electrolyte ions, and the electrical double layer capacitance C_{dl} at the low frequency region.

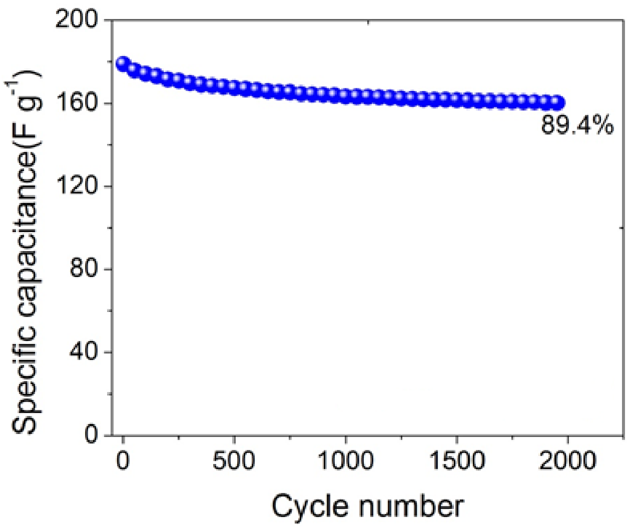

Figure S12. Cyclic stability test by charge-discharge of the HAPC-11-900 symmetric cell over 2000 cycles at the current density of 4 A g^{-1}.