Supplementary Materials

Facile Enhancement of Electrochemical Performance of Solid-State Supercapacitor *via* Atmospheric Plasma Treatment on PVA-based Gel-Polymer Electrolyte

Dong-Hyun Kim [1,†], **Suk Jekal** [1,†], **Chan-Gyo Kim** [1], **Yeon-Ryong Chu** [1], **Jungchul Noh** [2], **Min Sang Kim** [1], **Neunghi Lee** [1], **Woo-Jin Song** [3,4,5] **and Chang-Min Yoon** [1,*]

[1] Department of Chemical and Biological Engineering, Hanbat National University, Daejeon 34158, Republic of Korea
[2] McKetta Department of Chemical Engineering and Texas Material Institute, The University of Texas at Austin, Austin, TX, USA
[3] Department of Polymer Science and Engineering, Chungnam National University, Daejeon 34134, Republic of Korea
[4] Department of Chemical Engineering and Applied Chemistry, Chungnam National University, Daejeon 34134, Republic of Korea
[5] Department of Organic Materials Engineering, Chungnam National University, Daejeon 34134, Republic of Korea

[†] These authors equally contributed.
[*] Correspondence: cmyoon4321@hanbat.ac.kr; Tel.: +82-42-821-1528, Fax: +82-42-821-1593.
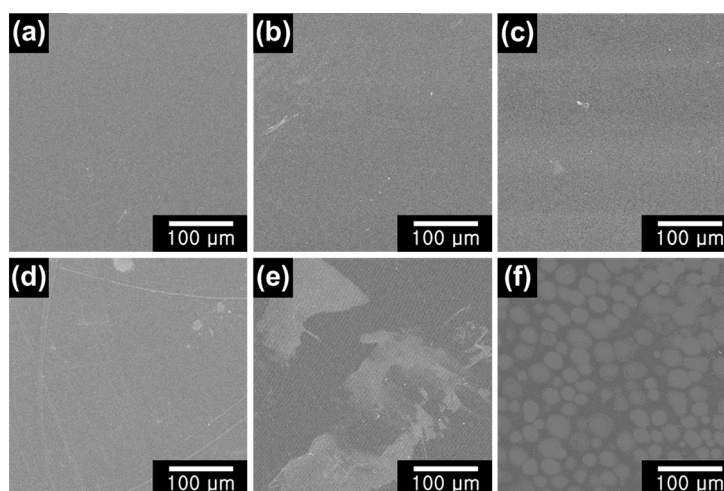
Figure S1. SEM images of (a) pristine PVA, (b) PVA-80W5, (c) PVA-100W5, (d) PVA-120W5, (e) PVA-140W5, and (f) PVA-160W5.

Table S1. Swelling ratios of pristine and plasma-treated PVAs after immersed in aqueous solution (1.0 M Na_2SO_4), EtOH, and commercial electrolyte (1.0 M $LiPF_6$ in EC/EMC 3:7).

Materials	Swelling ratio (M_{wet}/M_{dry}) [a]		
	1.0 M Na_2SO_4	Ethanol	1.0 M $LiPF_6$ in EC/EMC 3:7
pristine PVA	2.3	1.7	1.6
PVA-120W5	3.6	2.6	1.8
PVA-120W10	3.3	2.4	1.6
PVA-120W15	3.2	2.3	1.3
PVA-120W20	3.2	2.3	1.4
PVA-120W25	2.7	1.9	1.1

[a] Swelling ratios were calculated by dividing mass of dried various plasma-treated PVA matrix (M_{dry}) by mass of immersed wet plasma-treated PVA matrix in various solutions for 10 s (M_{wet}).
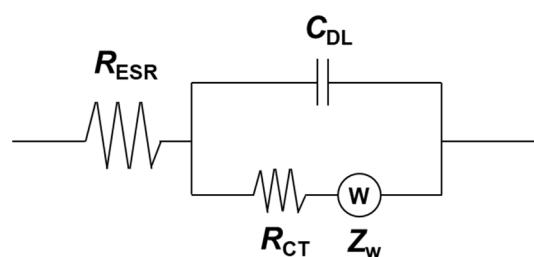
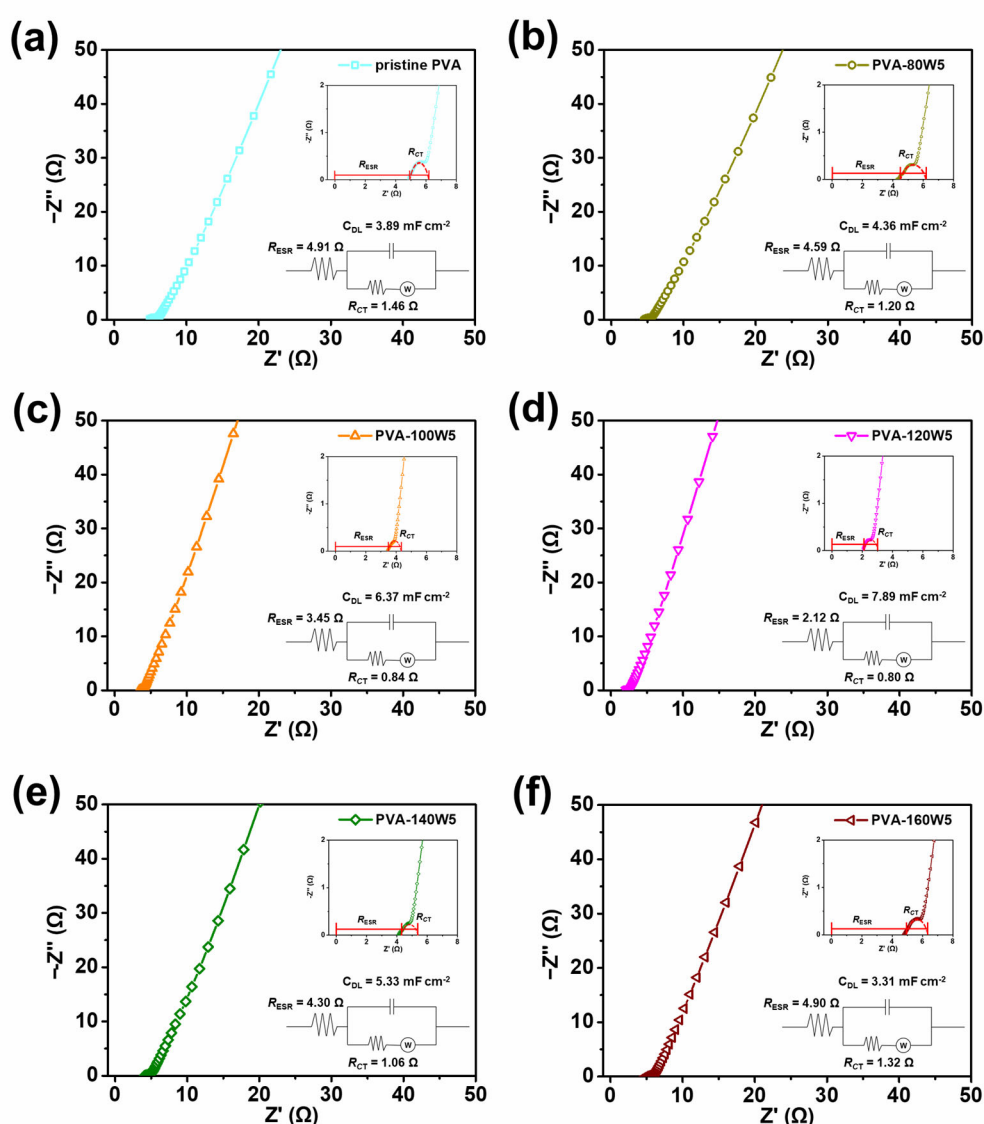**Figure S2.** Electrochemical equivalent circuit model for the EIS analysis.

Figure S3. Electrochemical impedance spectroscopy (EIS) analysis including the equivalent circuit model for the SSC devices employing (a) pristine PVA, (b) PVA-80W5, (c) PVA-100W5, (d) PVA-120W5, (e) PVA-140W5, and (f) PVA-160W5.
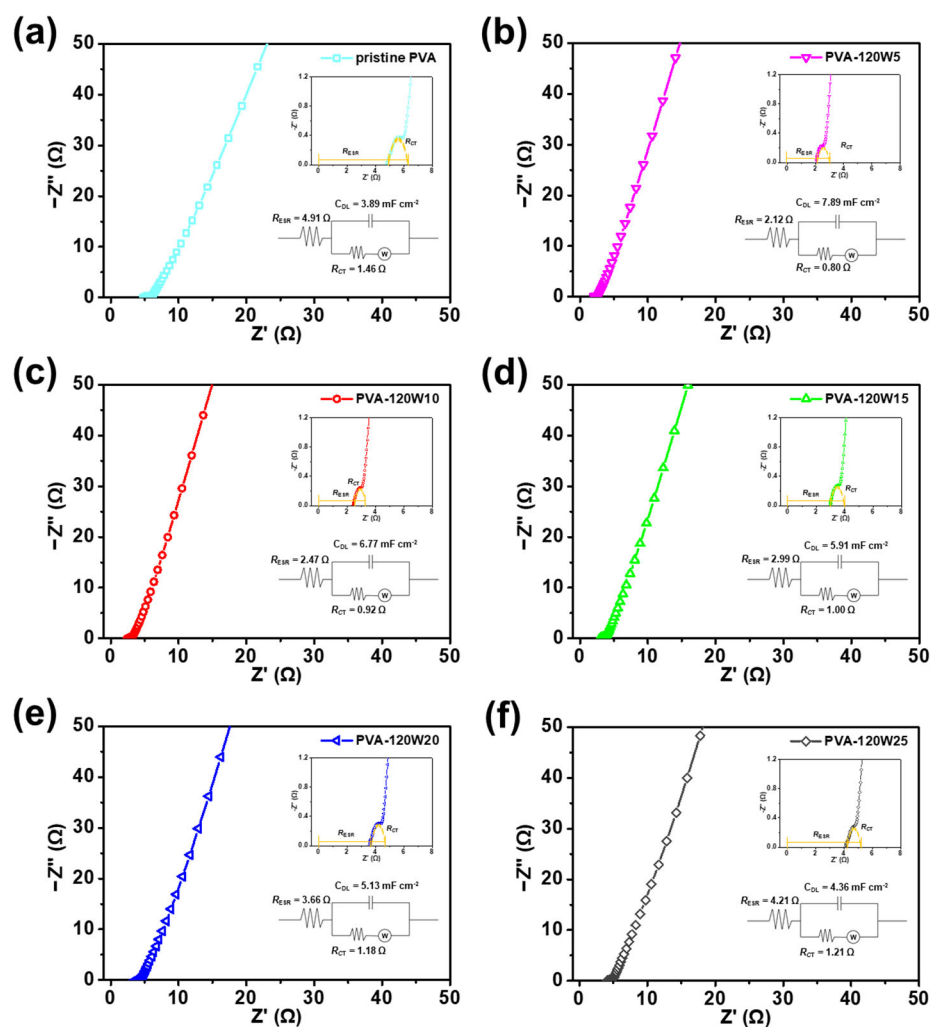
Figure S4. EIS analysis including the equivalent circuit model for the SSC devices employing (a) pristine PVA, (b) PVA-120W5, (c) PVA-120W10, (d) PVA-120W15, (e) PVA-120W20, and (f) PVA-120W25.
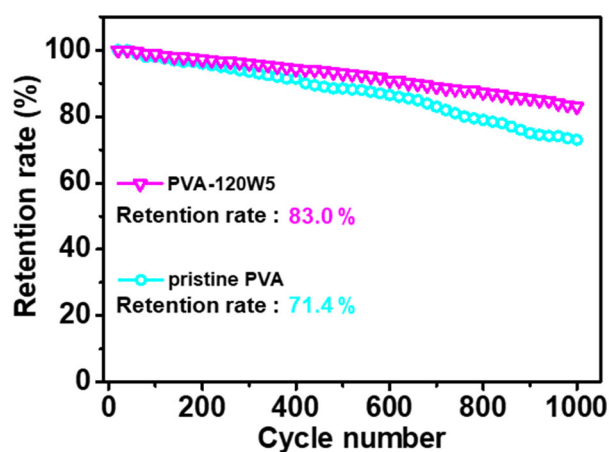

Figure S5. Long-term cycling test of the SCC device employing pristine PVA and PVA-120W5 with the current density of 5 mA cm^{-2}.