Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information for:

Surface-modified spherical activated carbon for high carbon loading and its desalting performance in flow-electrode capacitive deionization

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SEM & TEM

Scanning electron microscopy (SEM, Hitachi S4800, Japan) analysis was performed at 10 kV to observe the surface morphology of the AC and the surface-modified AC. Transmission electron microscopy (TEM, Tecnai FT30 ST, Netherlands) was used to monitor the thickness of the polymer layer on the Pt coated AC and on the synthesized particles that were prepared using a Focused Ion Beam (FIB, Quanta 3D FEG, Netherlands) with a Ga source.

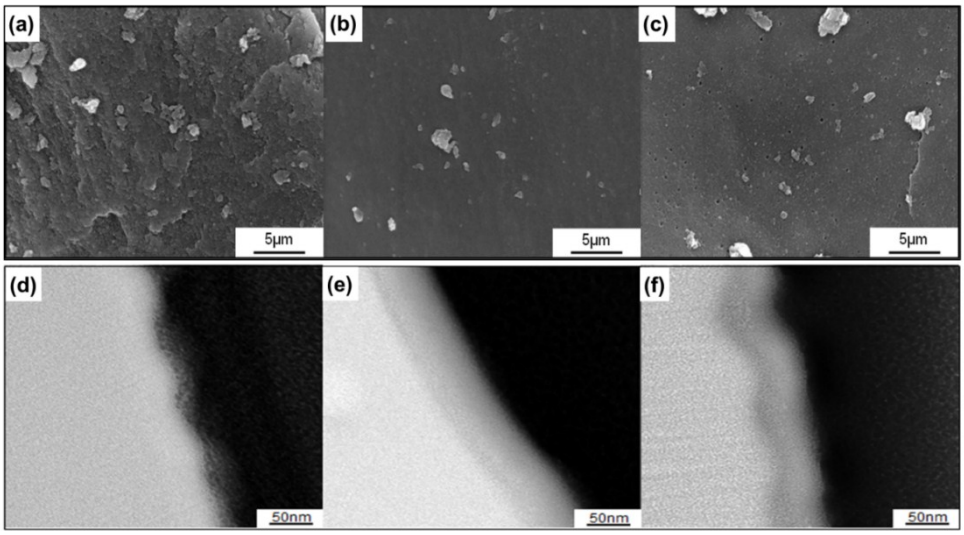

Figure S1. SEM images of (a) bare AC, (b) AC-N, and (c) AC-S. TEM images of (d) bare AC, (e) AC-N, and (f) AC-S. For TEM images, samples were treated by FIB.

BET

Specific surface areas and pore volumes were determined by nitrogen (N_2) adsorption data in the relative pressure range of 0.05 to 0.2 using the Brunauer-Emmett-Teller (BET) method.

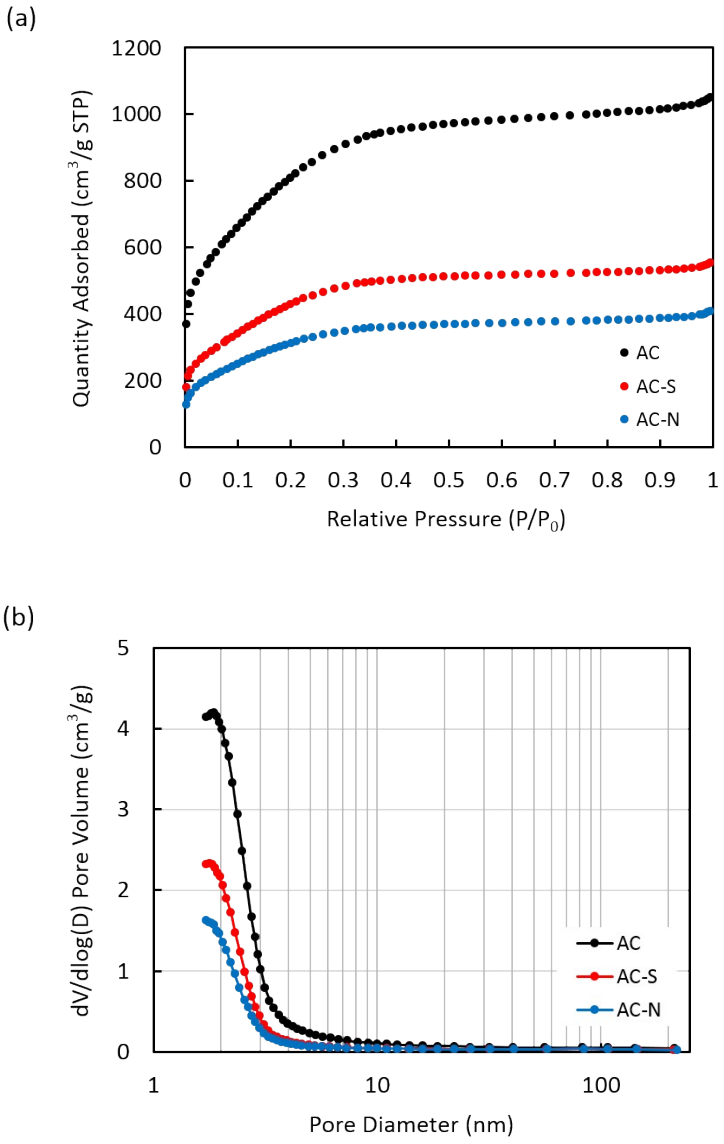

Figure S2. (a) Nitrogen adsorption isotherm and (b) pore size distribution of AC materials

Point of zero charge (PZC)

Point of zero charge (PZC) was measured by mass titration method. The samples, AC and surface-modified AC, were fully prewashed for 18 h with deionized water. Three different initial pH solutions (pH 4, 8, 12) were adjusted by HCl and NaOH. Five different amounts (0.05, 0.1, 0.5, 1, 5, 10 g) of the samples were used and filled with 100 mL of three different pH solutions, respectively. The equilibrium pH was determined after 24 hr.

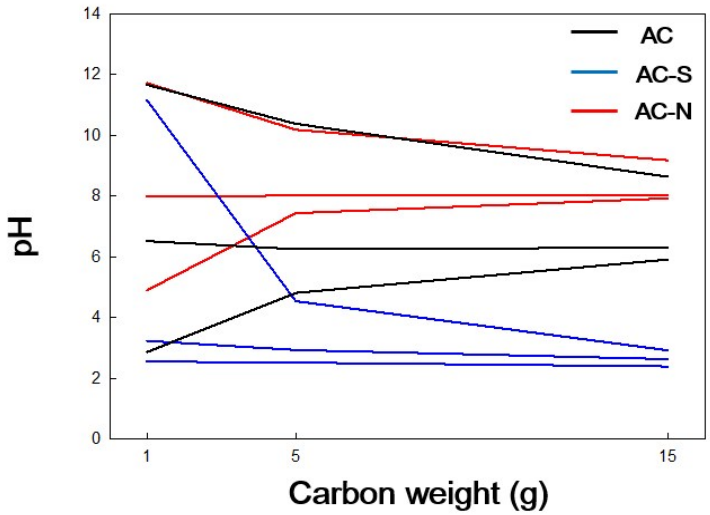

Figure S3. Point of zero charge measured by mass titration method; bare AC and surface-modified ACs.

Deionization test using FCDI system by 1-tank mode

For 1-tank mode, the flow electrode was made by mixing 35% AC-N with NaCl solution (2.5%). From one tank, this slurry was simultaneously supplied to anode and cathode by a pump, and met together in the tank after passing through the flow path. This circulation was kept during the desalting test. The conductivity and current were measured by a potentiostat.

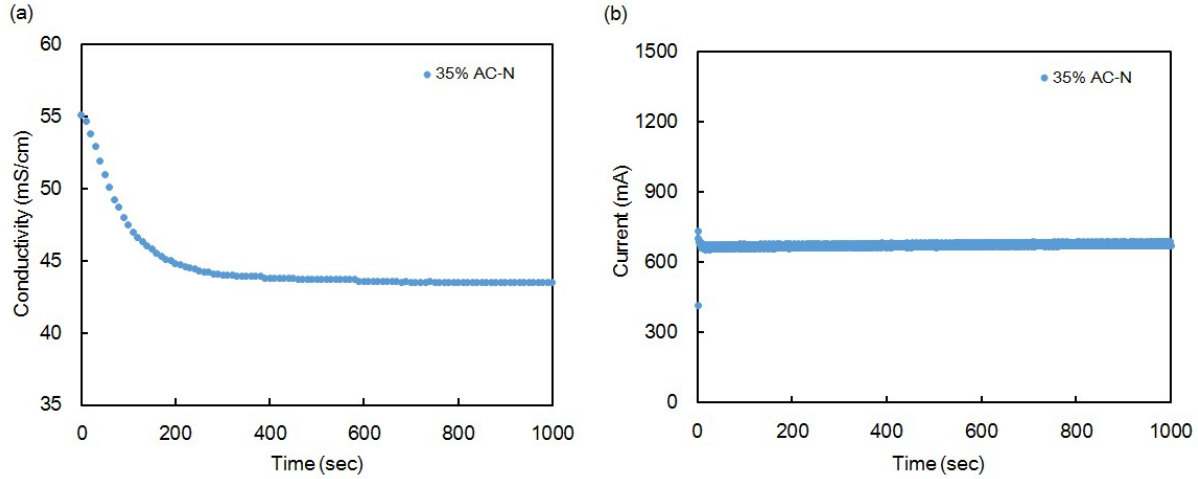

Figure S4. Profiles of (a) NaCl conductivity changes and (b) current of 35% AC-N flow-electrode as a function of time.

Table S1. Results of desalting process based on 50% AC-N in FCDI system.

Flow electrode composition (anode/cathode)	Concentration (%)	Maximum salt removal efficiency (%)	Current efficiency (%)
AC-N/AC-N	35	20.5	85.0

Reference

1. J. S. Noh and J. A. Schwarz, *Carbon*, 1990, **28**, 675-682.