Electronic Supplementary Material (ESI) for Environmental Science: Nano.

Supporting Information

Controlling hierarchical porous structures of rice husk derived carbons for improved performances of capacitive deionization

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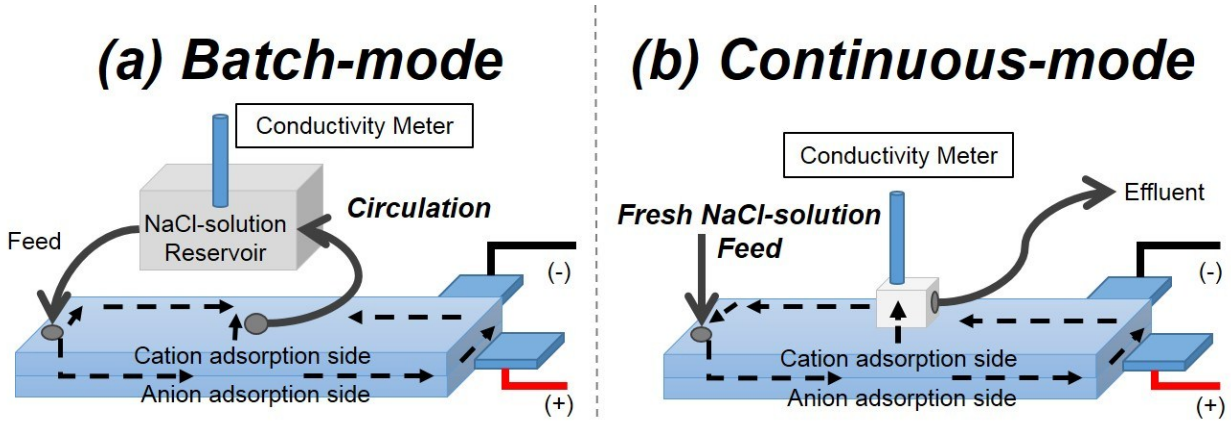

Figure S1 Experimental setup to evaluate the CDI performance (a) batch-mode, (b) continuous-mode system. Batch mode configuration allows to evaluate the maximum adsorption capacity and kinetic performance of electrode materials. In the continuous mode system, we can show the desalination performance in practical application.

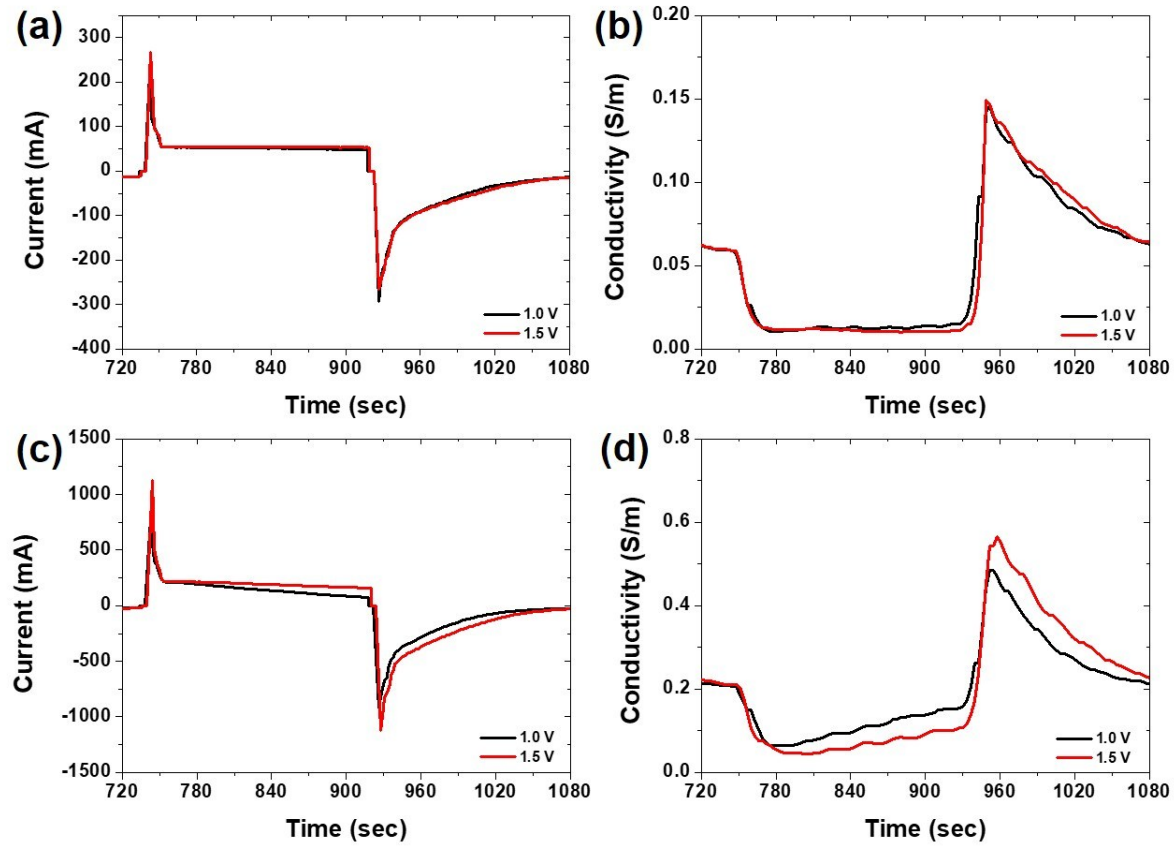

Figure S2 Example of current and conductivity curves of AC in the continuous mode operation. There was no particular current fluctuations between 1.0 V and 1.5 V of cell voltage in the concentration of (a), (b) 250 ppm and (c), (d) 1000 ppm. Because of the high overpotential due to the use of a low concentration of NaCl solution and the carbon electrode without the catalyst for water splitting, it seems that water electrolysis do not occur even at applying a voltage of 1.5 V.

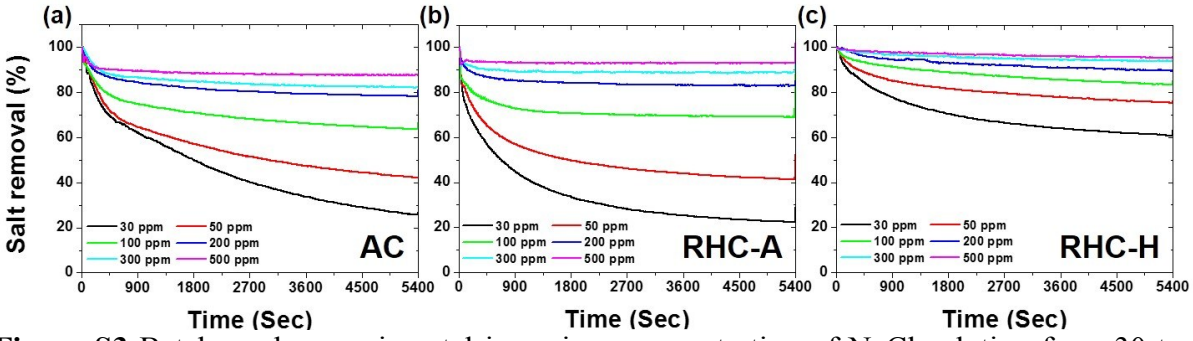

Figure S3 Batch-mode experimental in various concentration of NaCl solution from 30 to 500 ppm. The Y-axis converted to the salt removal efficiency.

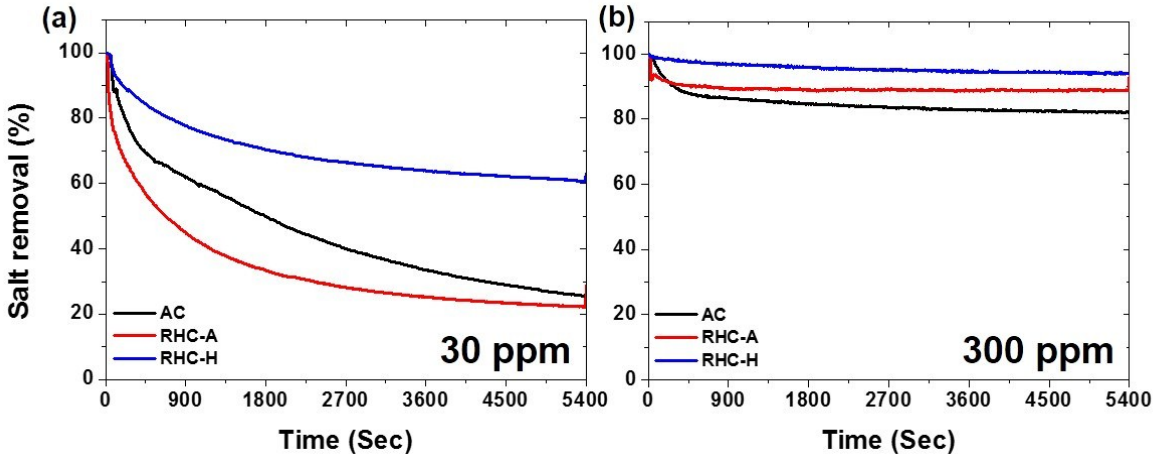

Figure S4 Represented CDI performance in concentration of (a) 30 ppm, and (b) 300 ppm.

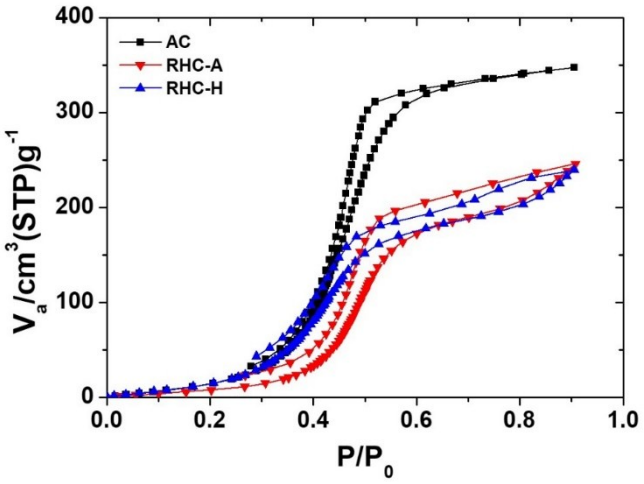

Figure S5 Water adsorption isotherms on the AC, RHC-A and RHC-H. Mesopore-dominant porous carbon of the RHC-H shows relatively favorable for water adsorption than the microporous AC. Water adsorption of the RHC-A with silicon components shifts to higher relative pressures, indicating hydrophobic surface properties. Nevertheless, the RHC-A has the best performance due to the proper pore structure of combination of micro- and mesopores for the practical CDI application.

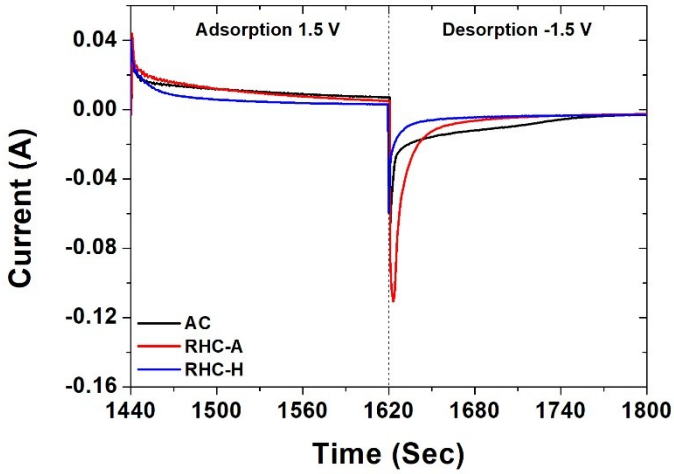

Figure S6 Charge-discharge curves of continuous mode CDI experiment at 5th cycle. In the RHC-A, the initial current value of the adsorption and desorption process is larger than other samples because of fast ion movement through the hierarchical porous structure. The microporous AC has a gradual slope curve because the ion has to overcome the narrow pore structure for high capacity.

Table S1 Effect of activation time of RHC on surface characteristics

Activation time*	BET-surface area (m2/g)	Total pore volume (cm3/g)	Average pore diameter (nm)
30 min	531	0.28	2.09
60 min	582	0.32	2.19
90 min	440	0.30	2.77

* Samples were not treated with HCl aqueous solution.

Table S2 Representative capacitive performance of the porous carbon materials

	Capacitance @ 1 A/g (F/g)	Langmuir isotherm			Pseudo second-order kinetics				Continuous CDI performance		
		q_m (mg/g)	K_L	R^2	$q_{e,\ experiment}$ (mg/g)	$q_{e,\ calculation}$ (mg/g)	k_2	R^2	η (%)	q (mg/g)	q (ug/m^2)
AC	60.3	17.7	0.0148	0.970	9.95	10.26	0.00024	0.970	16.4	5.40	6.27
RHC-A	42.2	9.1	0.0978	0.994	8.17	8.28	0.00093	0.968	25.6	8.09	15.46
RHC-H	7.2	5.7	0.0339	0.951	4.36	4.96	0.00018	0.963	5.2	1.63	6.10