Supporting Information

Even-distributed Sulfur-doped Nickel Zinc Hydroxyl Carbonate Dispersed Structure for All-solid-state Asymmetric Supercapacitors with Enhanced Performances

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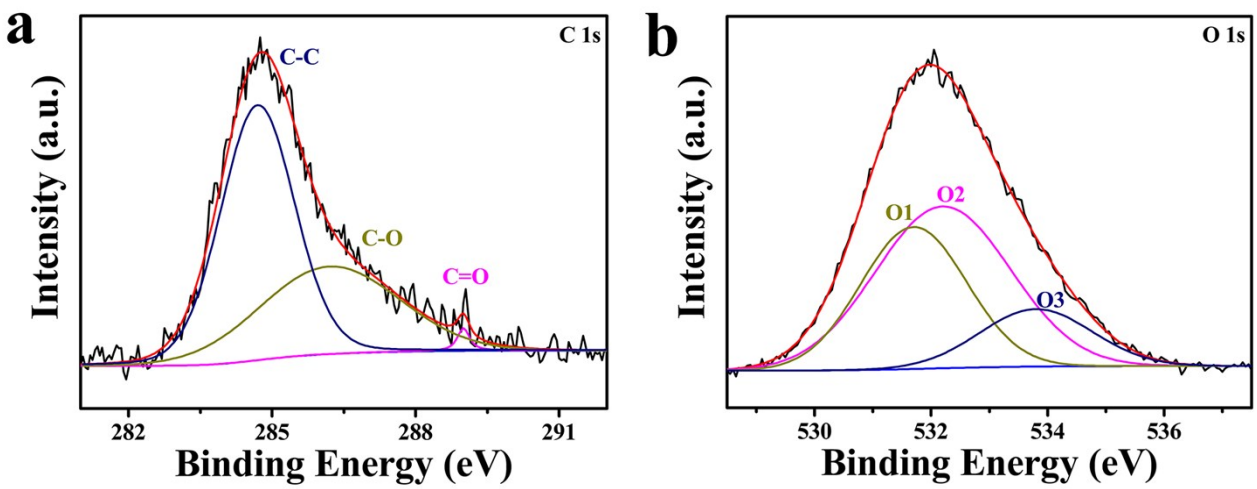

Fig. S1 XPS spectra of NZSC-4: (a) C 1s and (b) O 1s

As shown in Fig. S1a, C 1s spectrum can be easily decomposed into three components as shown: 284.7 (C=C), 286.2 (C-O) and 289 (C=O) eV,[1-3] indicating the presence of citric acid and CO_3^{2-}. The high resolution O 1s spectrum in Fig. S1b can be fitted into three distinct peaks named as O1, O2 and O3, respectively. The O1 peak at 531.7 eV attribute to spin–orbit doublet characteristics of OH^-; the O2 peak at 532.2 eV indicates carbonyl carbon (C=O); the O3 peak at 533.7 eV represents the physi- and chemisorbed water.[2-4]

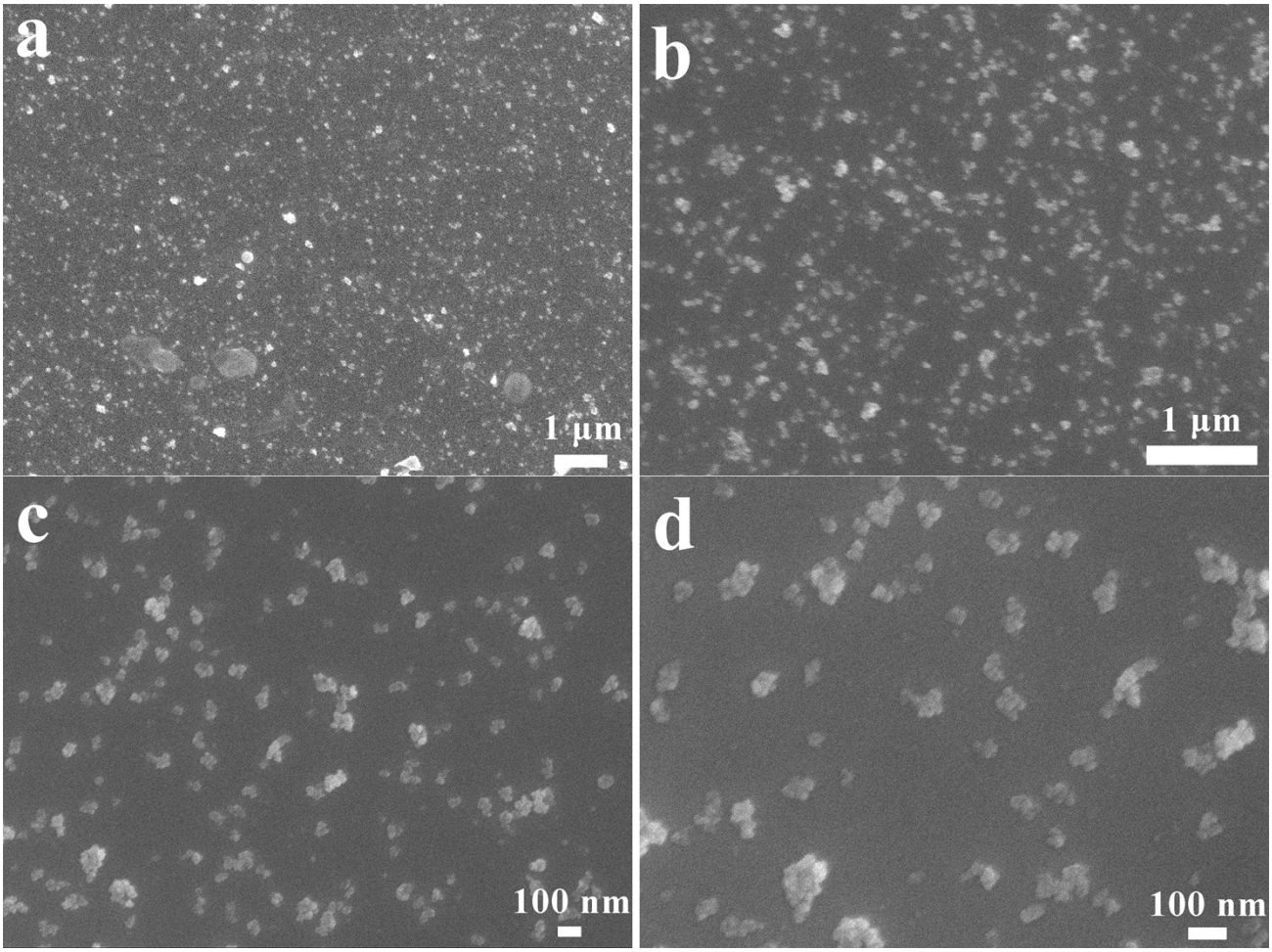

Fig. S2 FESEM images of NZSC-4 at different magnifications.

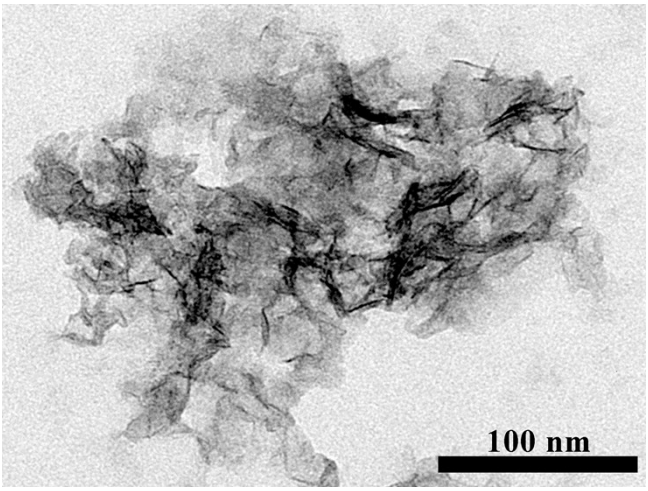

Fig. S3 TEM image of NZC.

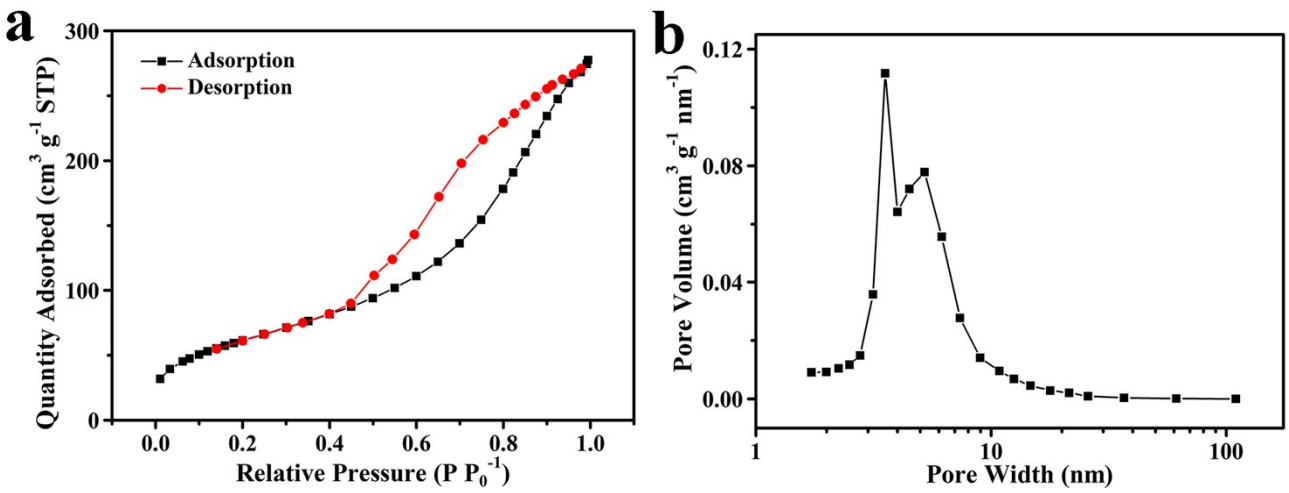

Fig. S4 (a) N_2 adsorption-desorption isotherms and (b) corresponding BJH pore-size distribution curves of the NZSC-4.

The amount of electricity required for electrolysis is 1 mol of the active material is 1F, equal to 96485 C. For $NiS_{33.3}Zn_{32.3}$, the molar mass is 3238.23 g mol^{-1}, however, the element involved in the Faraday oxidation-reduction reaction is nickel (Zn would not to be covered), molar mass is 90.76 g mol^{-1}, so the theoretical Faraday capacitance is calculated as follows:[5]

$$C = \frac{Q}{U} = \frac{96485 \times 1/90.76}{U}$$

Where U is the voltage window, Q is electrical energy per 1 gram. When U is 0.45V in charge/discharge measurement, the theoretical faradaic capacitance is about 2362.4 F g^{-1}.

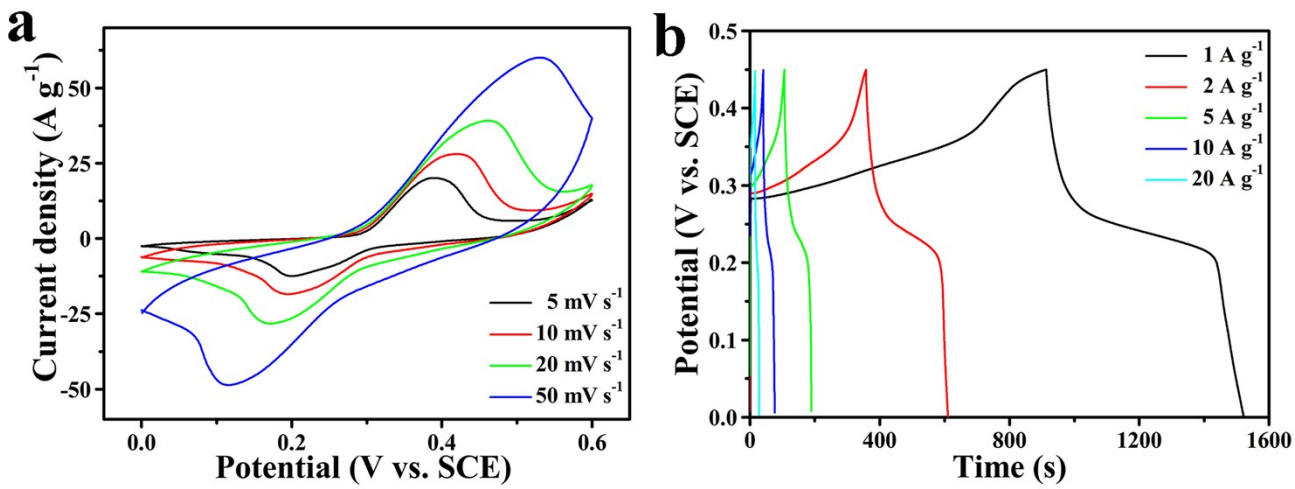

Fig. S5 (a) CV and (b) GCD curves of NZC

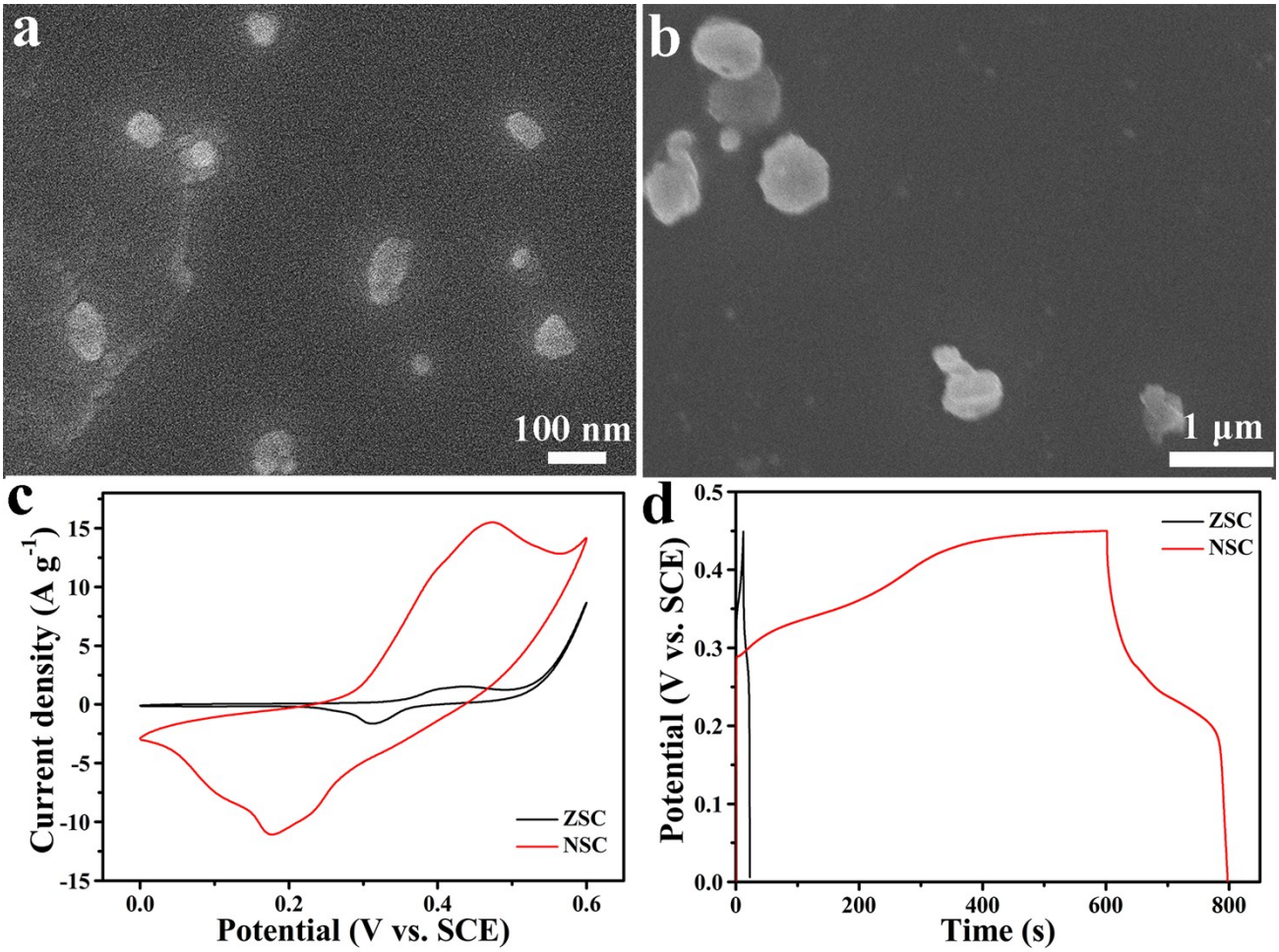

Fig. S6 FESEM images of (a) ZSC and (b) NSC; (c) CV curves of ZSC and NSC electrodes at a scanning rate of 10 mV s^{-1}; (d) GCD curves of ZSC and NSC at current density of 2 A g^{-1}.

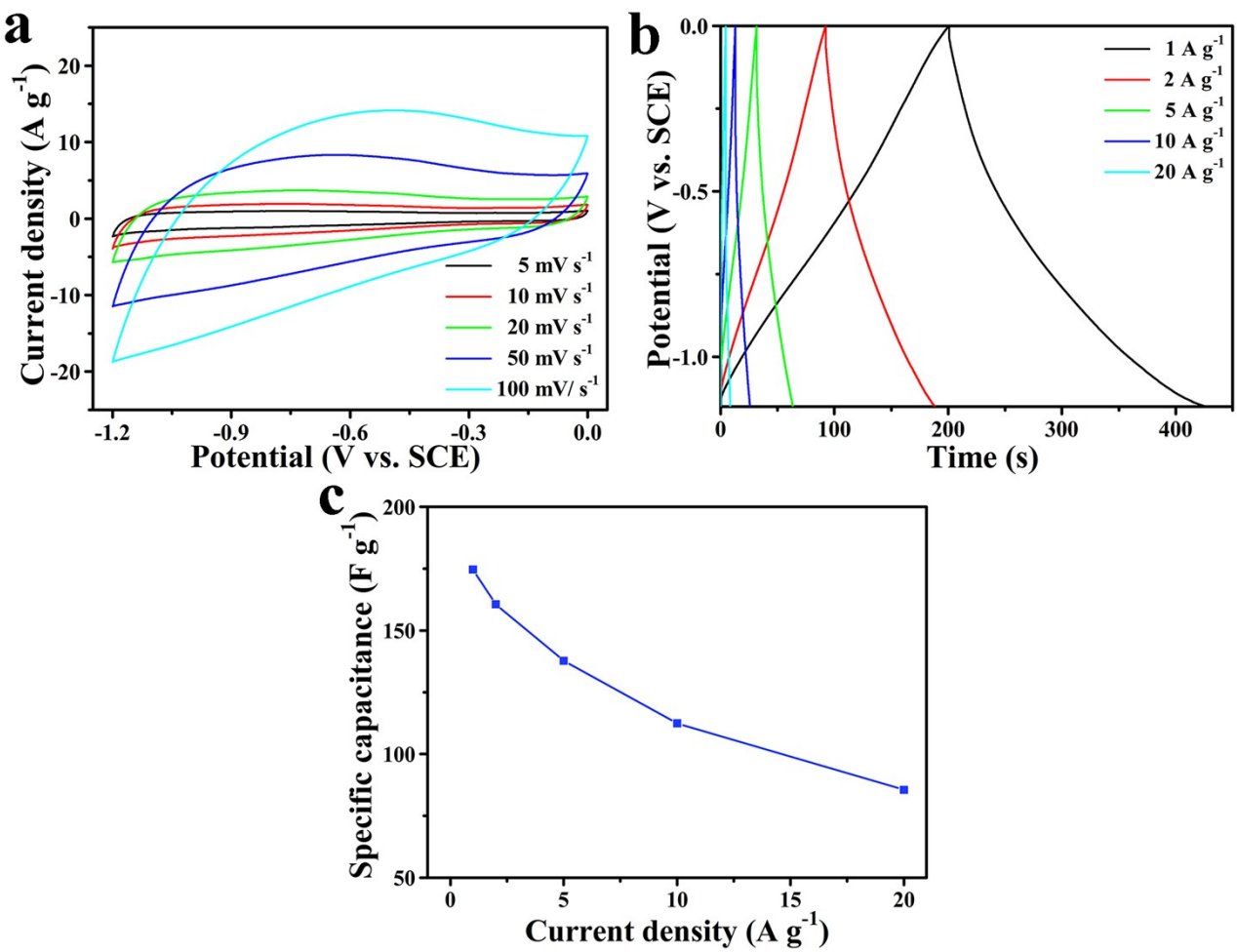

Fig. S7 (a) CV curves of AC; (b) GCD curves of NZSC-4 from -1.15 to 0 V at different current densities and (c) specific capacitance is calculated from the GCD curve.

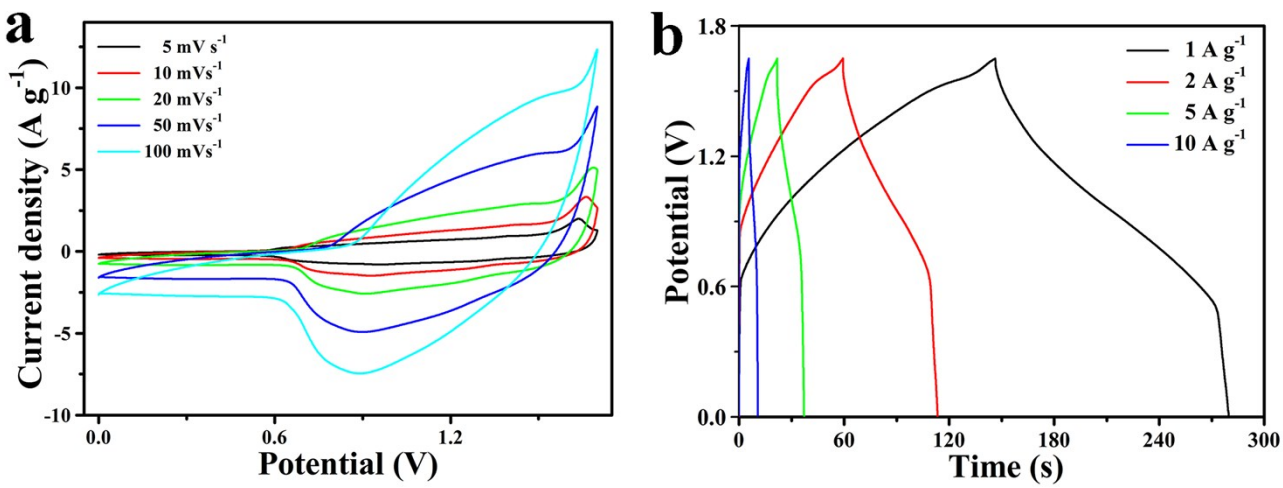

Fig. S8 (a) CV curves NZC//AC; (b) GCD curves of NZC//AC.

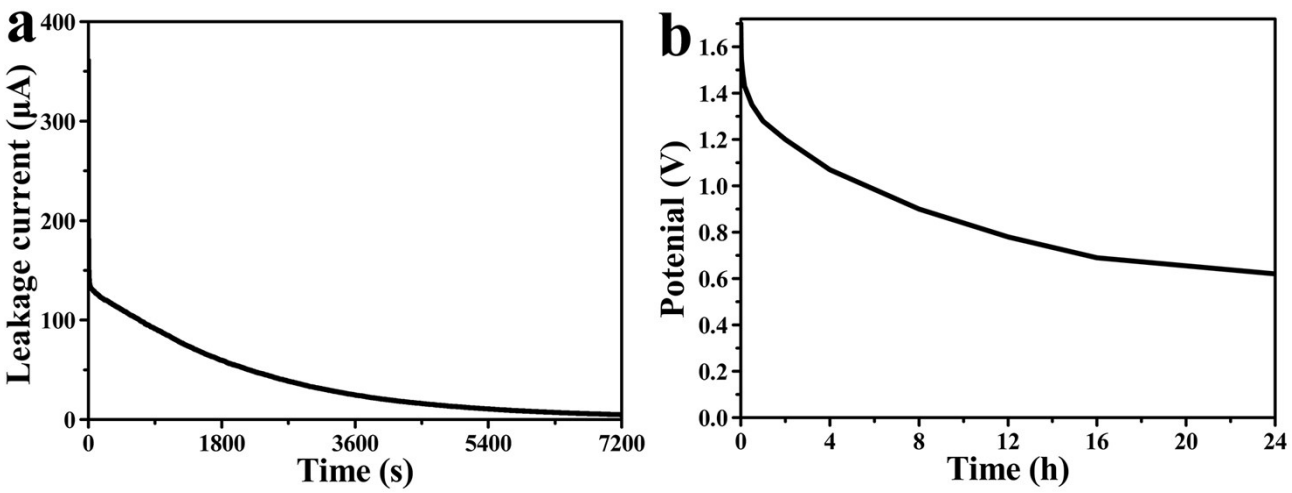

Fig. S9 (a) leakage current curve and (b) self-discharge curve of the NZSC-4//AC supercapacitor.

Table S1

Electrochemical performances of the as-prepared electrodes

Electrodes	specific capacitance (F g^{-1})					retention
	1 A g^{-1}	2 A g^{-1}	5 A g^{-1}	10 A g^{-1}	20 A g^{-1}	
NZC	1320	1122	934	786	580	44%
NZSC-1	580	560	450	320	180	31%
NZSC-2	1377	1211	1066	900	780	57%
NZSC-4	1634	1562	1411	1323	1194	73%

"Retention" means the specific capacitance at 20 A g^{-1} as compared with 1 A g^{-1}.

References

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