ESI:

Construction of mesoporous Cu-doped Co_9S_8 rectangular nanotube arrays for high energy density all-solid-state asymmetric supercapacitors

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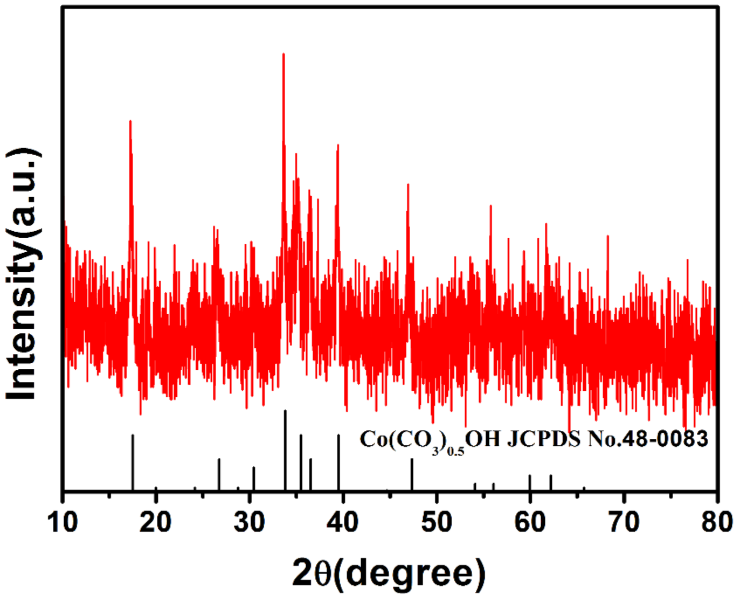

Fig. S1 XRD pattern of the as-prepared Cu-CCO NWAs.

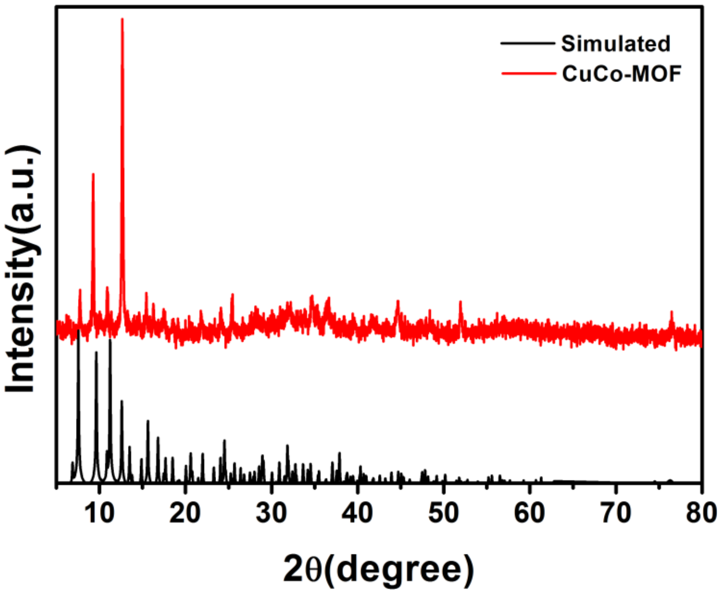

Fig. S2 XRD pattern of the as-prepared CuCo-MOF NRAs.

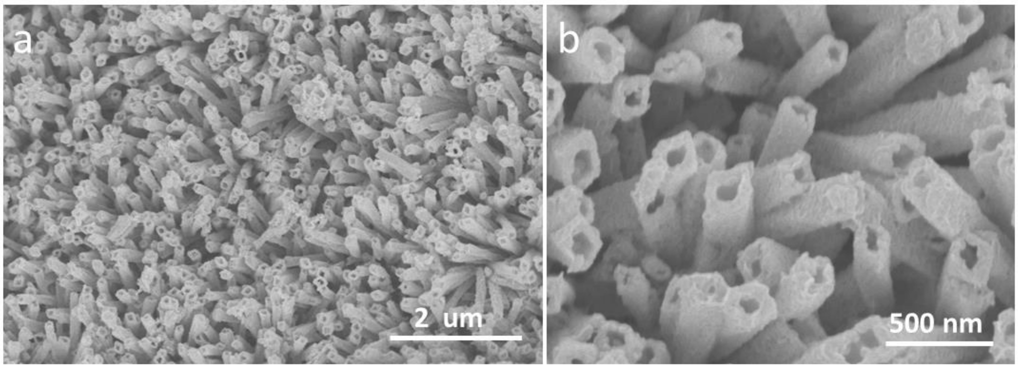

Fig. S3 (a, b) SEM images of the as-prepared Co_9S_8 rectangular NTAs.

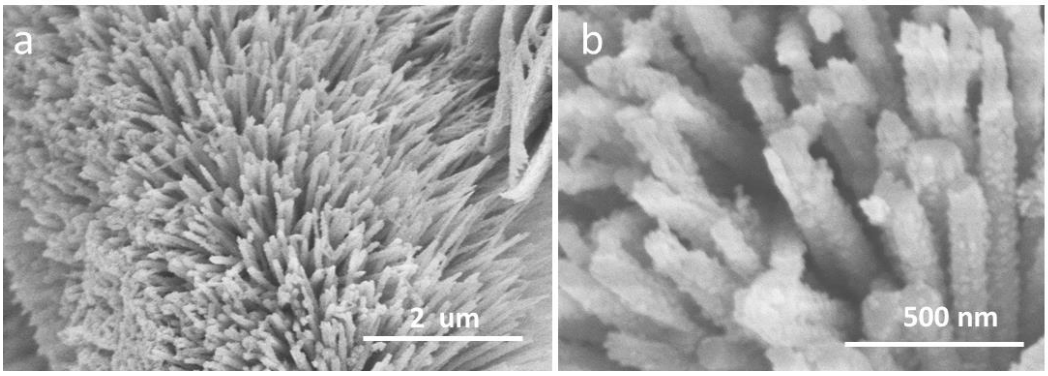

Fig. S4 (a, b) SEM images of the as-prepared Cu-Co_9S_8 NRAs.

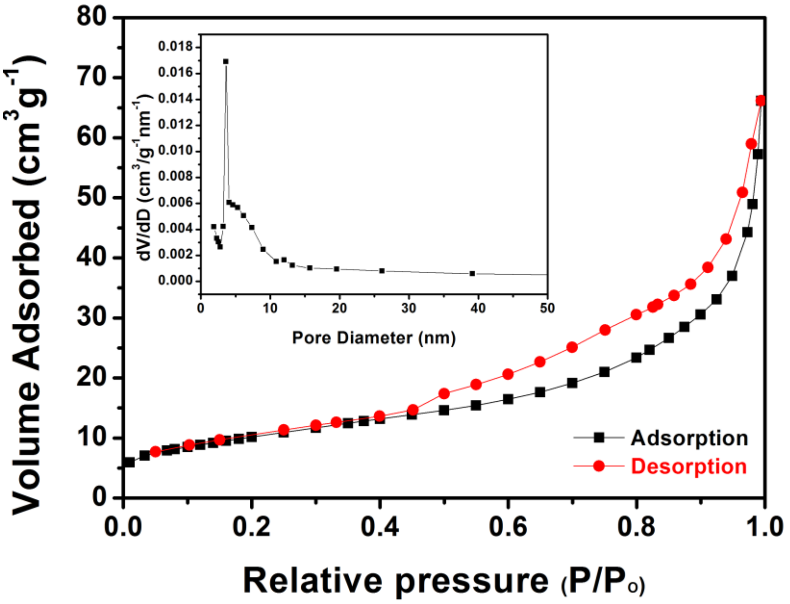

Fig. S5 N_2 adsorption-desorption isotherm and pore-size distribution curve of the as-prepared Cu-Co_9S_8 rectangular NTAs.

Table S1. Elemental contents of the as-prepared Cu-Co_9S_8 rectangular NTAs estimated from XPS.

Sample	Cu [at.%]	Co [at.%]	S [at.%]
Cu-Co_9S_8	2.78	26.7	22.96

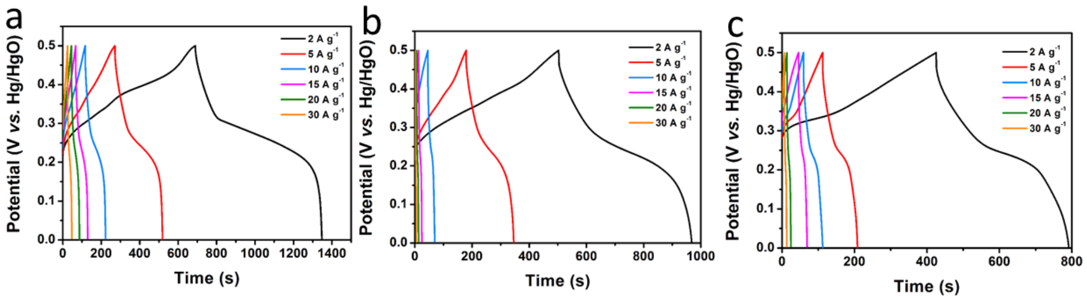

Fig. S6 (a, b, c) GCD curves of the as-prepared Cu-Co_9S_8 rectangular NTAs, Co_9S_8 rectangular NTAs and Cu-Co_9S_8 NRAs at various current densities (from 2 to 30 A g^{-1}).

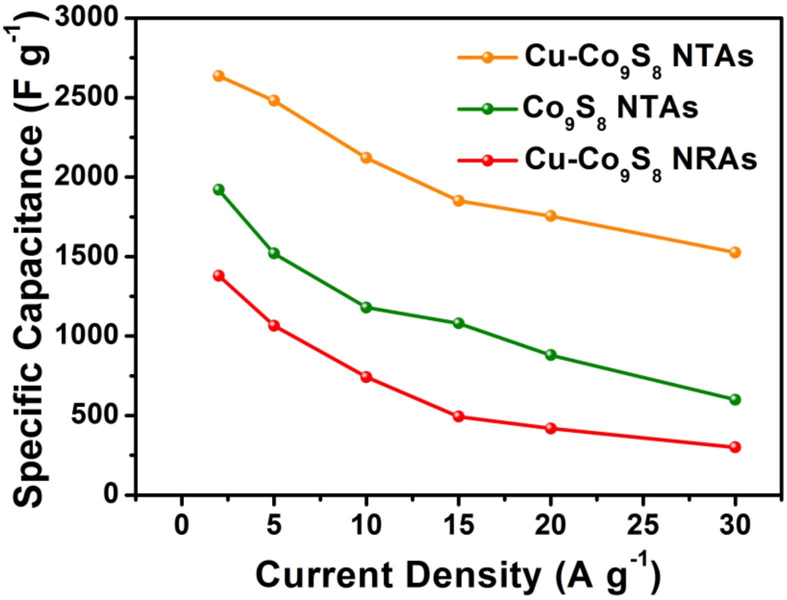

Fig. S7 Specific capacitances at different current densities of the as-prepared Cu-Co_9S_8 rectangular NTAs, Co_9S_8 rectangular NTAs and Cu-Co_9S_8 NRAs.

Table S2. Electrochemical performances of the different Co-based electrode materials.

Electrode Materials	Areal Capacitance/ capacity (F cm^{-2}/mA h cm^{-2})	Specific capacitance/ capacity (F g^{-1}/mA h g^{-1})	Electrolyte	Stability (Cycles)	References
Cu-Co_9S_8 NTAs	4.1 F cm^{-2}/ 0.57 mA h cm^{-2}	2636 F g^{-1}/ 366 mA h g^{-1}	6 M KOH	92% (5000)	This work
Co_9S_8/MnS@N-C @MoS_2	-	1938 F g^{-1}/ 306 mA h g^{-1}	2 M KOH	86.9% (10000)	1
Multi shelled CoO @Co_9S_8	-	1100 F g^{-1}	2 M KOH	83.7% (15000)	2
Co_9S_8@Ni(OH)$_2$	-	149.4 mA h g^{-1}	6 M KOH	97.3% (5000)	3
CoS hollow cubes	-	980 F g^{-1}	2 M KOH	88% (10000)	4
CC/H-Ni@Al-Co-S	-	1830 F g^{-1}	2 M KOH	90.6% (10000)	5
Co_9S_8@C	-	1877 F g^{-1}	2 M KOH	90% (10000)	6
Co_9S_8/NS-C-1.5 h	-	734 F g^{-1}	6 M KOH	99.8% (14000)	7
MCO-NW@CS	-	1607.4 F g^{-1}	2 M KOH	91.5% (6000)	8
Co_9S_8-NSA/NF	-	1098.8 F g^{-1}	1 M KOH	87.4% (1000)	9
$CuCo_2S_4$-HNN	-	2163 F g^{-1}	3 M KOH	98.7% (6000)	10
$FeCo_2S_4$-$NiCo_2S_4$	3.5 F cm^{-2}	1519 F g^{-1}	3 M KOH	77% (3000)	11
$Co_{0.67}Ni_{0.33}$DHs/ $NiCo_2O_4$/CFP	1.64 F cm^{-2}	-	1 M KOH	90% (2000)	12
36-CSC	2.35 F cm^{-2}	-	3 M KOH	92% (2000)	13
HO-$CuCo_2O_4$	0.6 F cm^{-2}	1210 F g^{-1}	6 M KOH	93.5% (4000)	14
$NiCo_2O_4$ Nanosheets	3.51 F cm^{-2}	-	2 M KOH	93.3% (3000)	15
$NiCo_2O_4$ Nanowire	3.12 F cm^{-2}	-	2 M KOH	89.4% (2000)	16
$ZnCo_2O_4$@ $Ni_xCo_{2x}(OH)_{6x}$	419.1 μA h cm^{-2}	-	2 M KOH	85.6% (2000)	17
$CoSe_2$	332 mF cm^{-2}	-	1 M Na_2SO_4	95.4% (5000)	18
$FeCo_2O_4$ tube	1.88 F cm^{-2}	1254 F g^{-1}	3 M KOH	91% (5000)	19

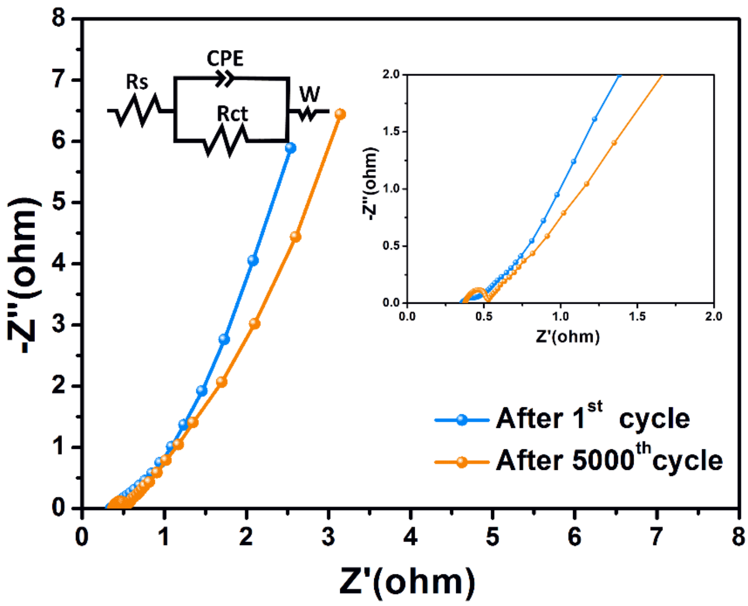

Fig. S8 EIS of the as-prepared Cu-Co_9S_8 rectangular NTAs electrode in three-electrode configuration (after 1st and 5000th cycling test).

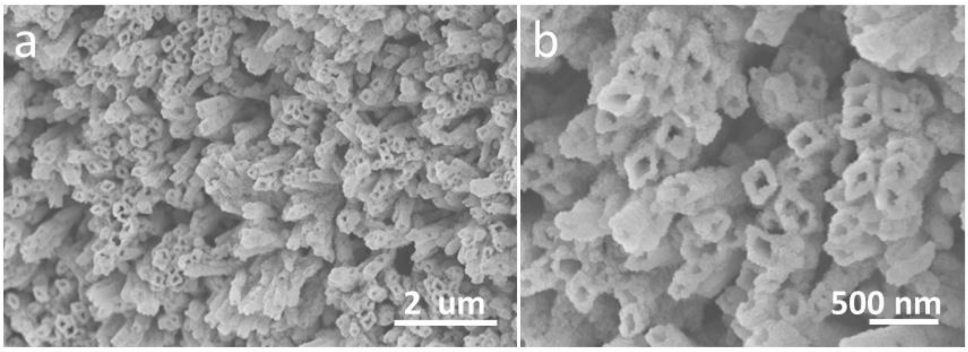

Fig. S9 (a, b) SEM images of the as-prepared Cu-Co_9S_8 rectangular NTAs after 5000 cycles test.

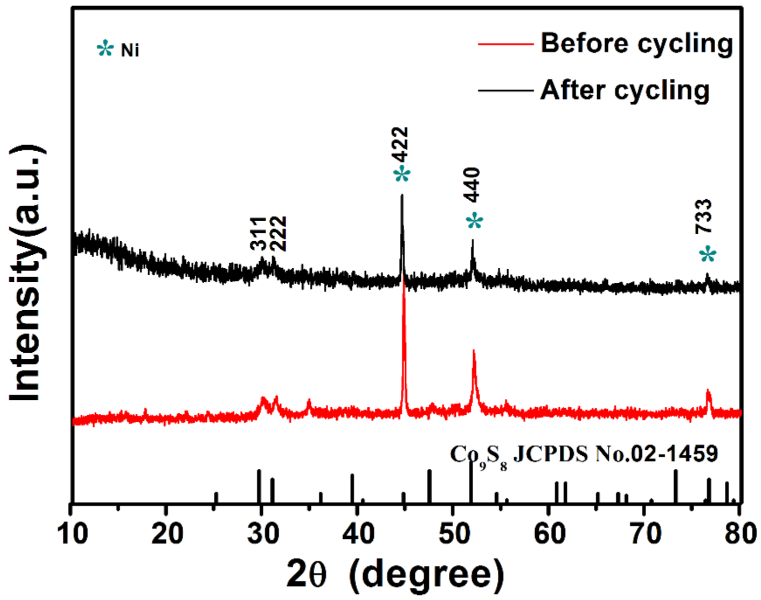

Fig. S10 XRD pattern of the as-prepared Cu-Co_9S_8 rectangular NTAs before and after cycling test.

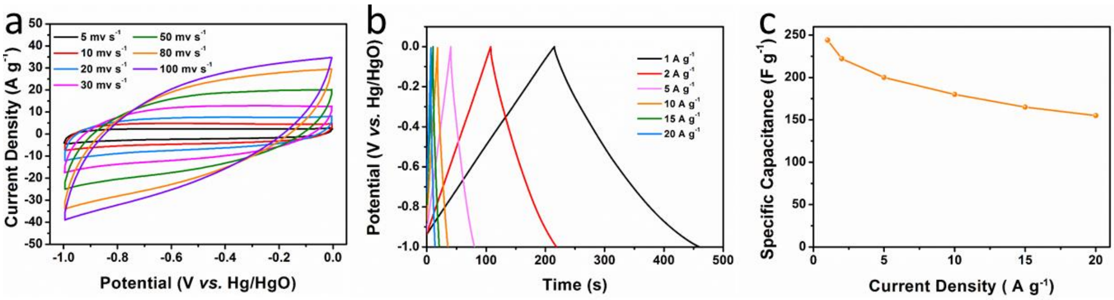

Fig. S11 (a) CV curves, (b) GCD curves, (c) Specific capacitance of the commercial AC.

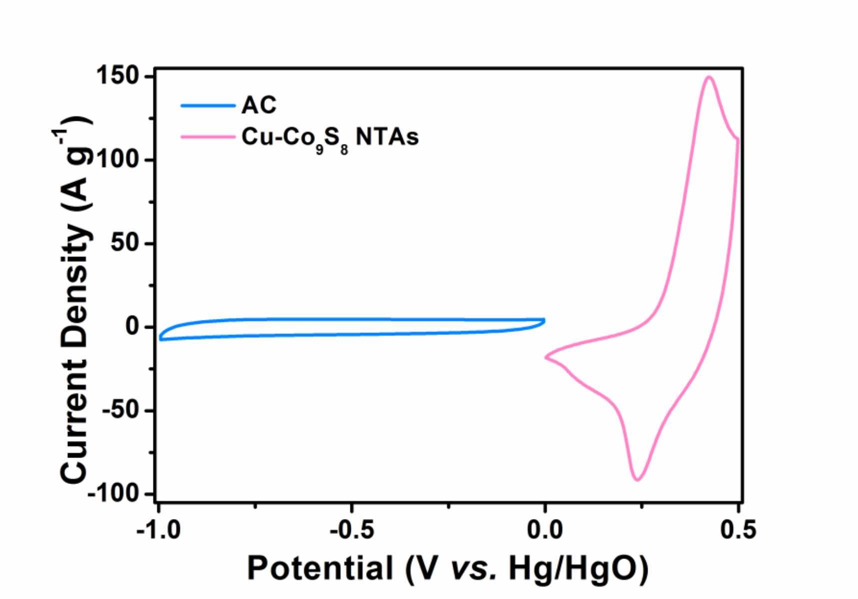

Fig. S12 CV curves of the commercial AC and the as-prepared Cu-Co_9S_8 rectangular NTAs.

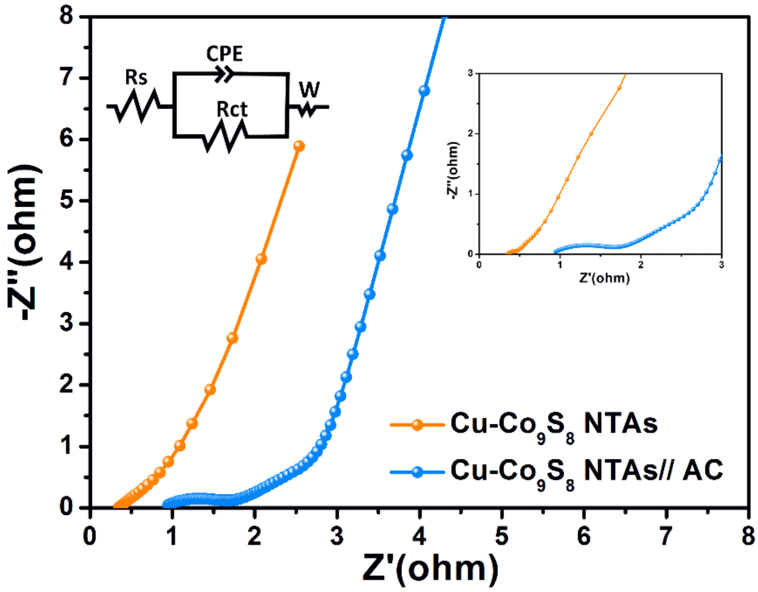

Fig. S13 EIS of the as-prepared Cu-Co_9S_8 and Cu-Co_9S_8//AC ASC device.

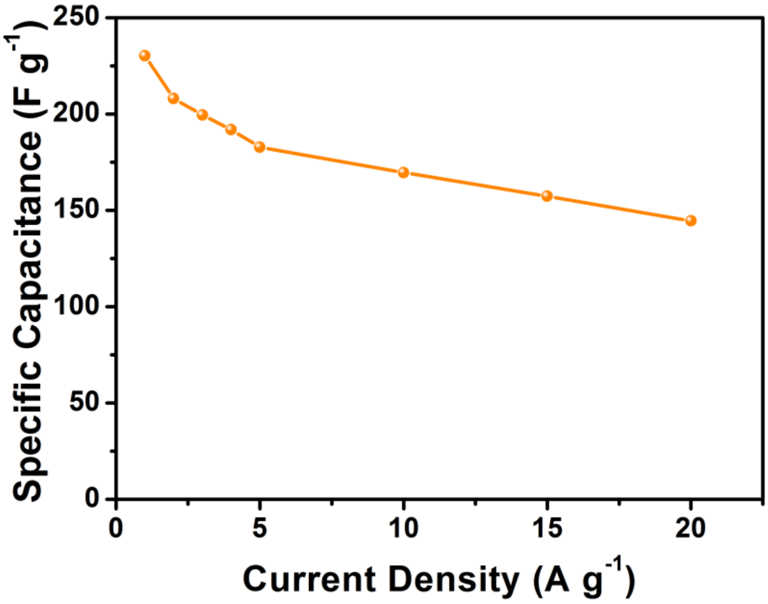

Fig. S14 Specific capacitance of the as-prepared Cu-Co_9S_8 rectangular NTAs at different current densities.

Table S3. ASC device properties comparison with the reported literature.

Electrode Materials	Areal Capacitance/capacity (F cm^{-2}/mA h cm^{-2})	Specific capacitance (F g^{-1})	Electrolyte	Stability (Cycles)	References
Cu-Co_9S_8 NTAs//AC	2.42 F cm^{-2}	230	PVA/KOH	96.2% (5000)	This work
CoO/Co_9S_8//AC	-	73	2 M KOH	95.27% (5000)	2
CC/H-Ni@Al-Co-S //graphene/CNT	-	159	PVA/KOH	90.6% (10000)	5
Co_9S_8@C//AC	-	166	2 M KOH	86% (10000)	6
$CuCo_2O_4$/$MnCo_2O_4$ //graphene/NF	-	118.4	2 M KOH	88.4% (10000)	21
Co_9S_8-NSA//AC	-	52.7	1 M KOH	84.4% (1000)	9
$CuCo_2S_4$–HNN//AC	-	124	3 M KOH	94.1% (6000)	10
$NiCo_2O_4$//$FeSe_2$	-	71.7	2 M KOH	90% (1000)	20
Co_9S_8/NS-C-1.5 h//AC	-	75.59	6 M KOH	99.5% (2000)	7
$MnCo_2O_4$@$Ni(OH)_2$//AC	-	141	2 M KOH	90% (2500)	22
H-$NiCoSe_2$//AC	-	112	6 M KOH	82.3% (5200)	23
Co_3O_4@$NiCo_2O_4$//AC	1343.7 mF cm^{-2}	-	PVA/KOH	98.5% (5000)	24
Co_3O_4@C@Ni_3S_2//AC	0.52 F cm^{-2}	-	PVA/KOH	91.43% (10000)	25
$NiCo_2O_4$@ $Co_{0.33}Ni_{0.67}(OH)_2$ //CMK-3-ASC	887.5 mF cm^{-2}	-	1 M KOH	82% (3000)	26
$Co(OH)_2$@CW//CW	2.2 F cm^{-2}	-	PVA/KOH	85% (10000)	27
$NiCo_2S_4$//C	341 mF cm^{-2}	-	6 M KOH	-	28
Cu_3N@CoFe-LDH//AC	1190 mF cm^{-2}	-	2 M KOH	92.6% (10000)	29
$MnO_2FeCo_2O_4$//AC	2.52 F cm^{-2}	-	PVA/KOH	94% (1500)	30

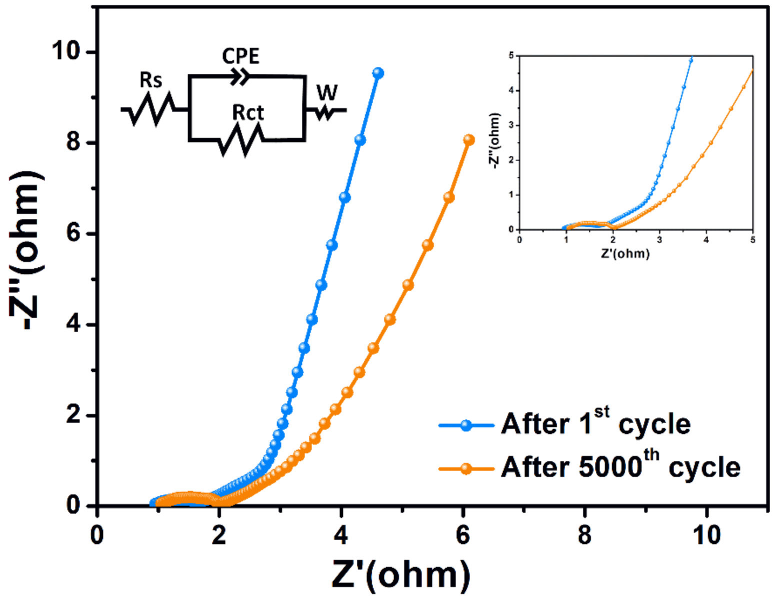

Fig. S15 EIS of the as-prepared ASC device (after 1st and5000th cycling test).

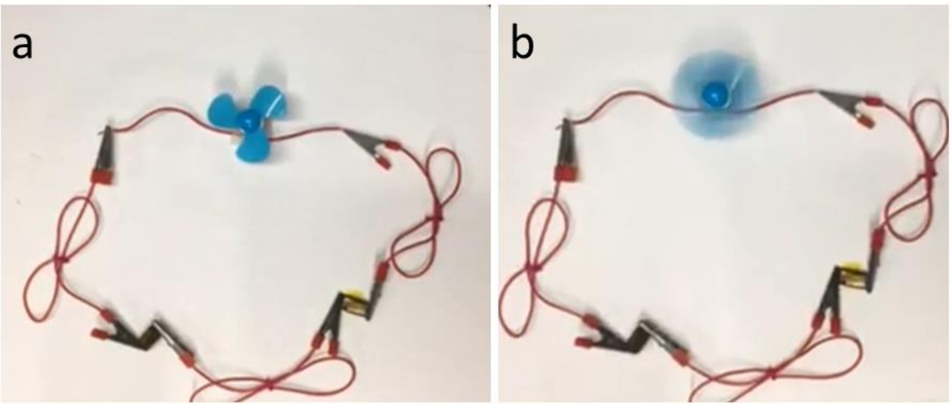

Fig. S16 (a, b) The photographic images of an electric motor fan driven by two Cu-Co_9S_8 NTAs//AC ASCs in series.

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