Electronic Supplementary Material (ESI) for Dalton Transactions.

Supplementary Information

3D Walking Palm-like Core-Shell $CoMoO_4$@$NiCo_2S_4$@Nickel Foam Composite for High-performance Supercapacitors

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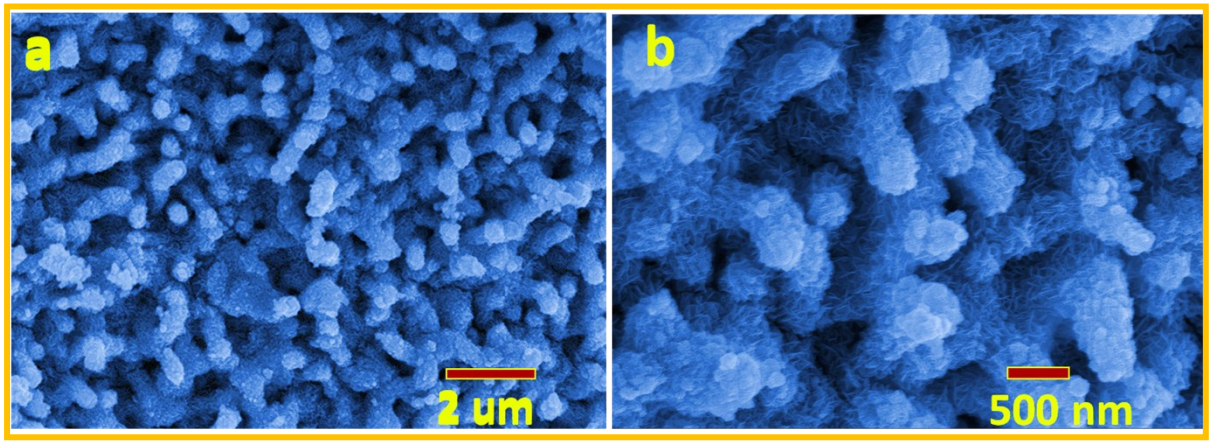

Fig. S1 SEM images of walking palm-like core-shell $CoMoO_4$@$NiCo_2S_4$@NF after 2 h of reaction at low (a) and high (b) magnifications.

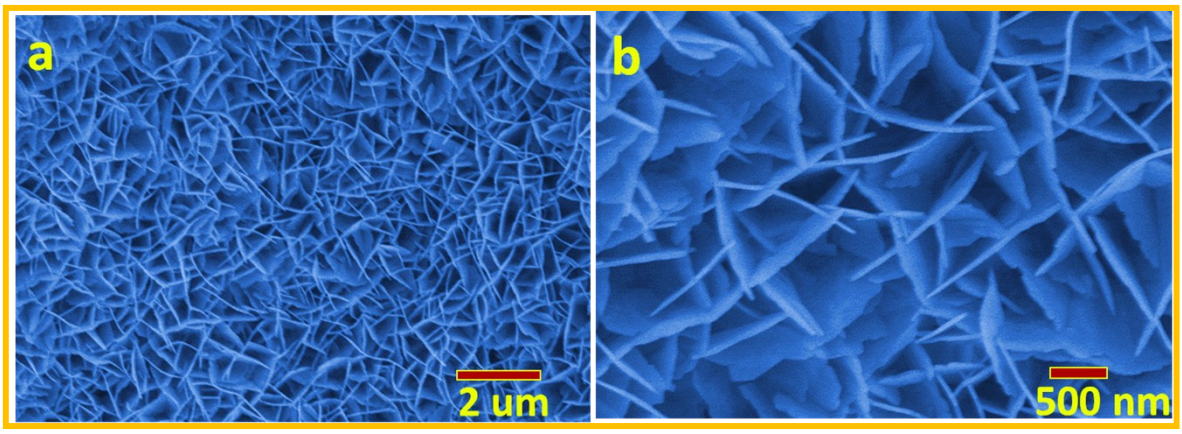

Fig. S2 SEM images of $CoMoO_4$@NF at low (a) and high (b) magnifications.

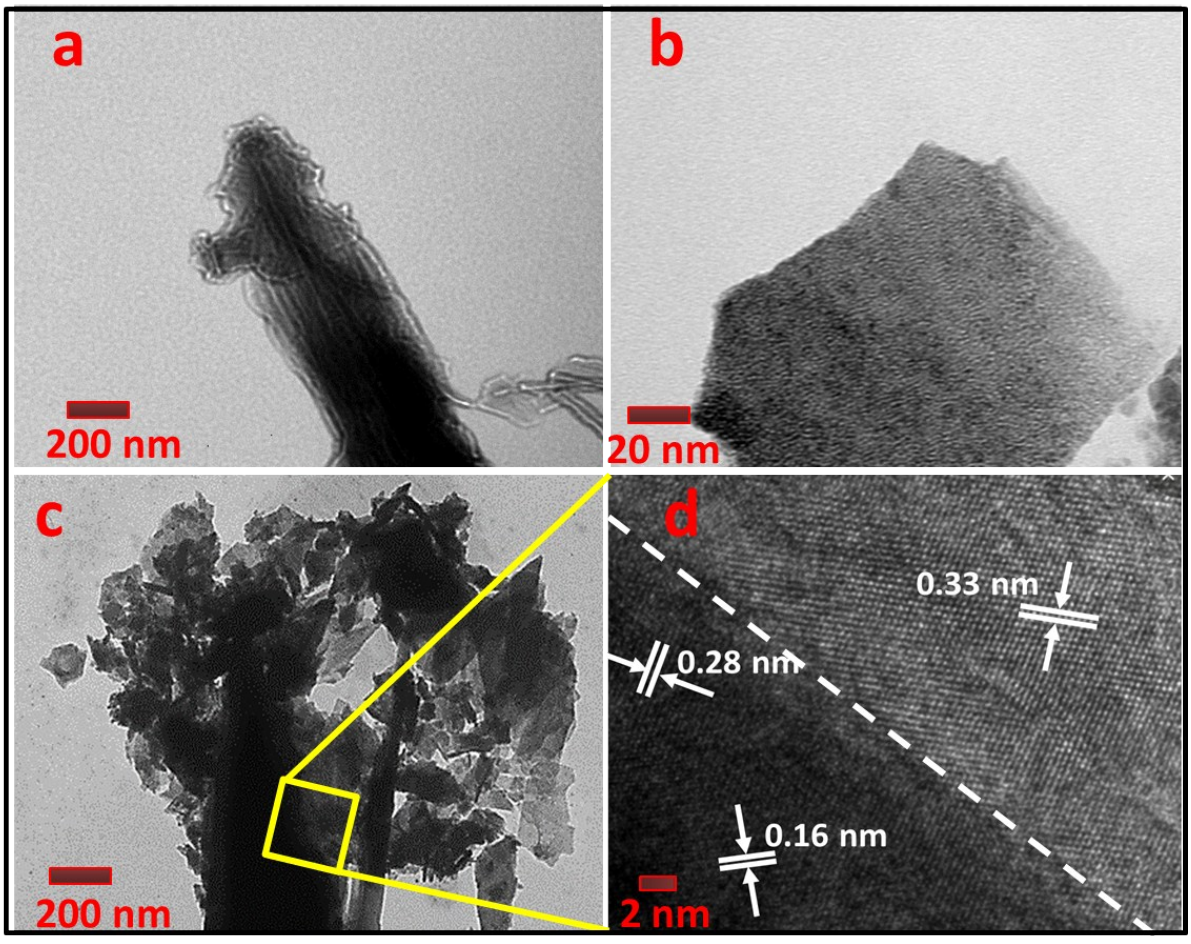

Fig. S3. TEM images of $NiCo_2S_4$ (a), $CoMoO_4$ (b), and walking palm-like core-shell $CoMoO_4$@$NiCo_2S_4$ (c); and HRTEM image of walking palm-like core-shell $CoMoO_4$@$NiCo_2S_4$ (d).

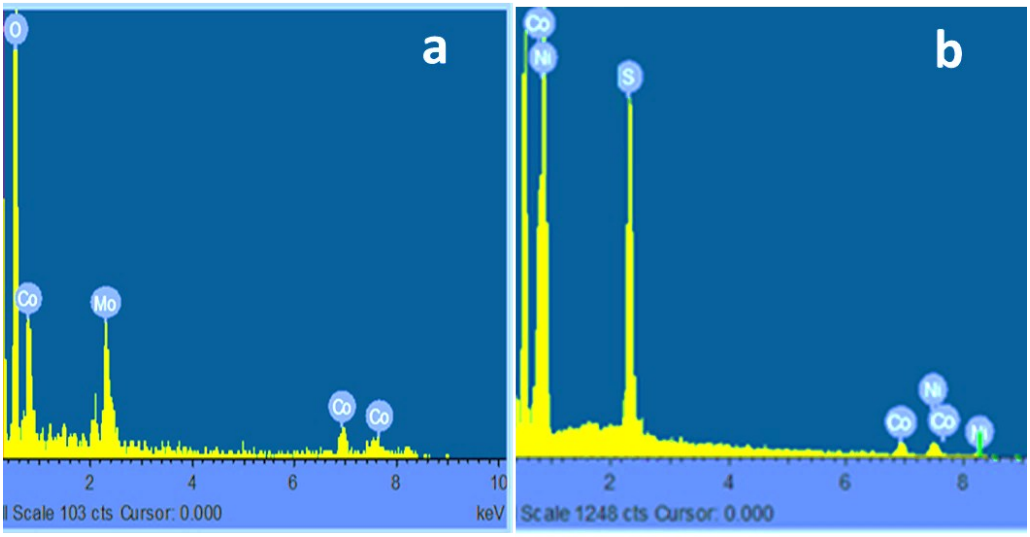

Fig. S4 EDS spectra of $CoMoO_4$@NF (a) and $NiCo_2S_4$@NF (b).

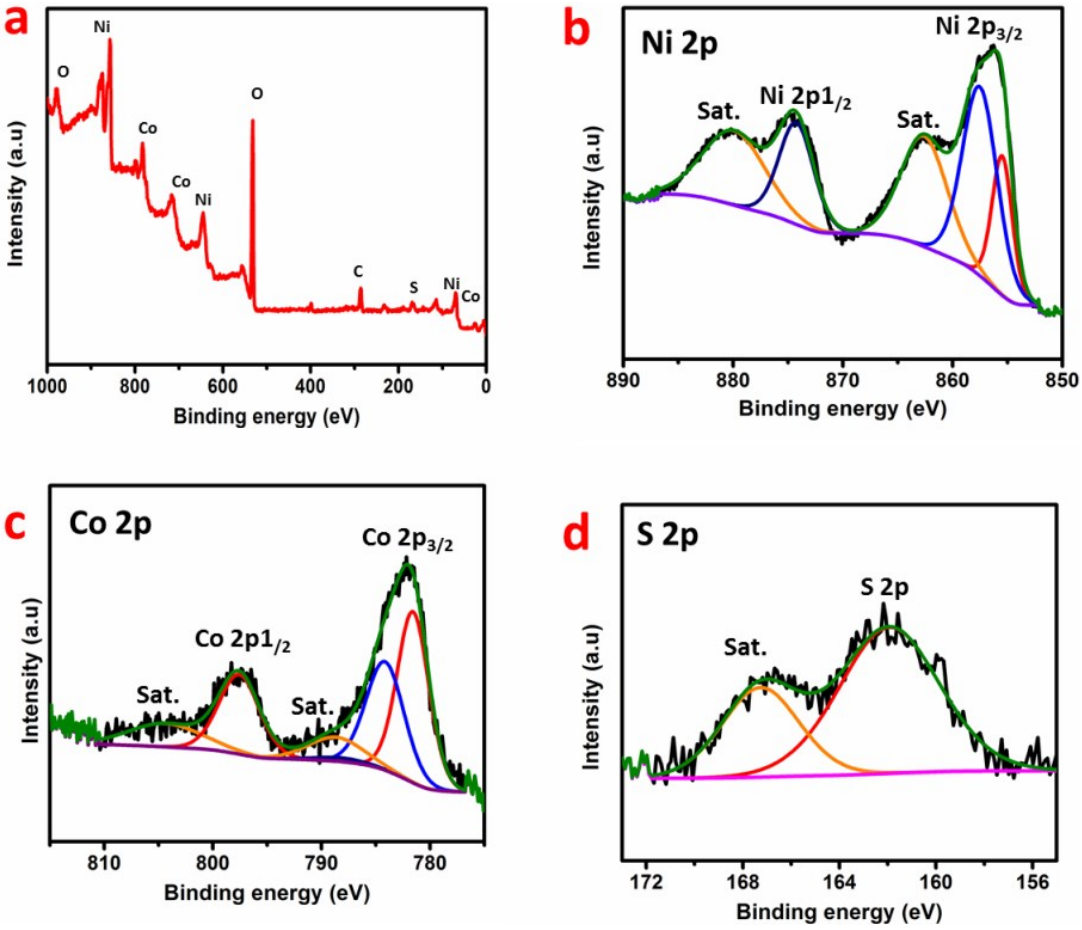

Fig. S5 XP spectra of the as-prepared $NiCo_2S_4$@NF: (a) survey, (b) Ni 2p, (c) Co 2p, and (d) S 2p.

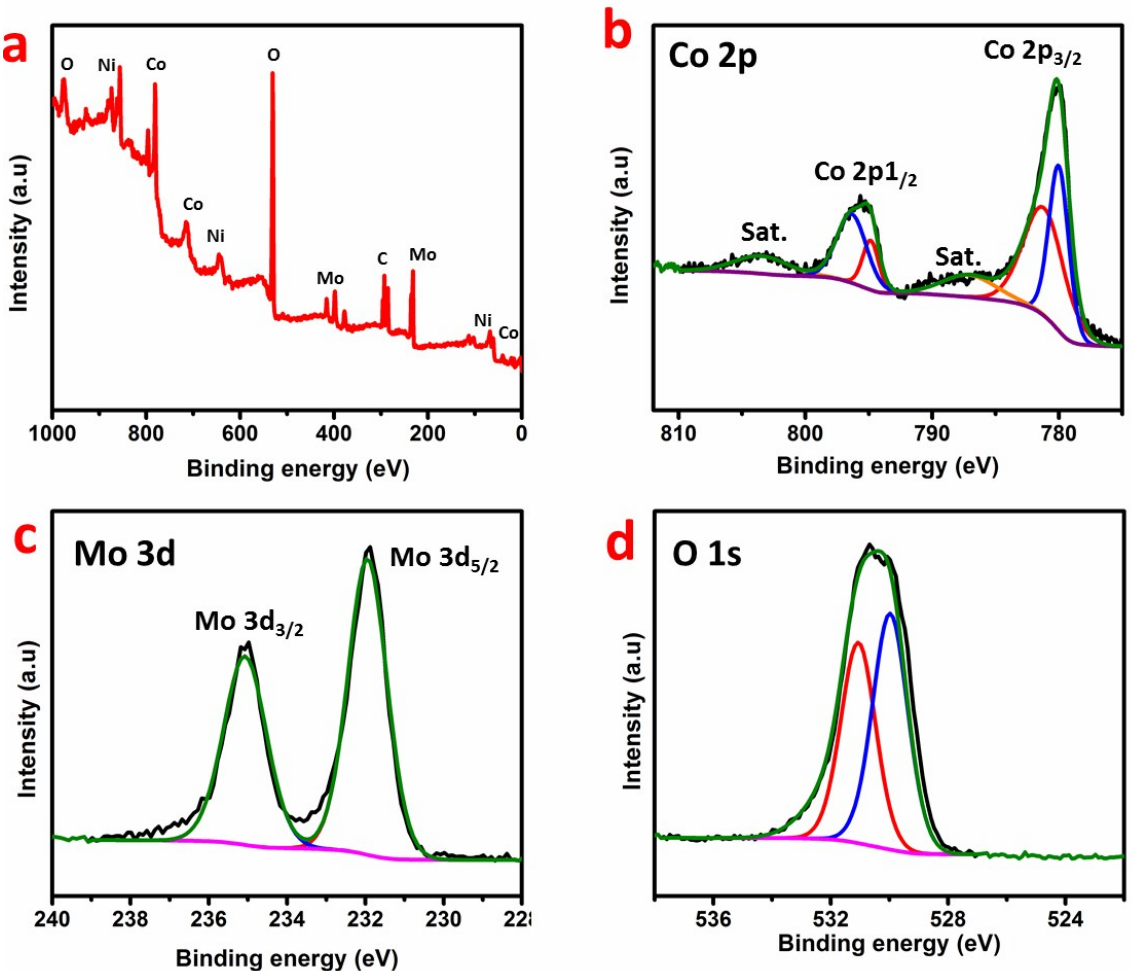

Fig. S6 XP spectra of the as-prepared $CoMoO_4$@NF: (a) survey, (b) Co 2p, (c) Mo 3d, and (d) O 1s.

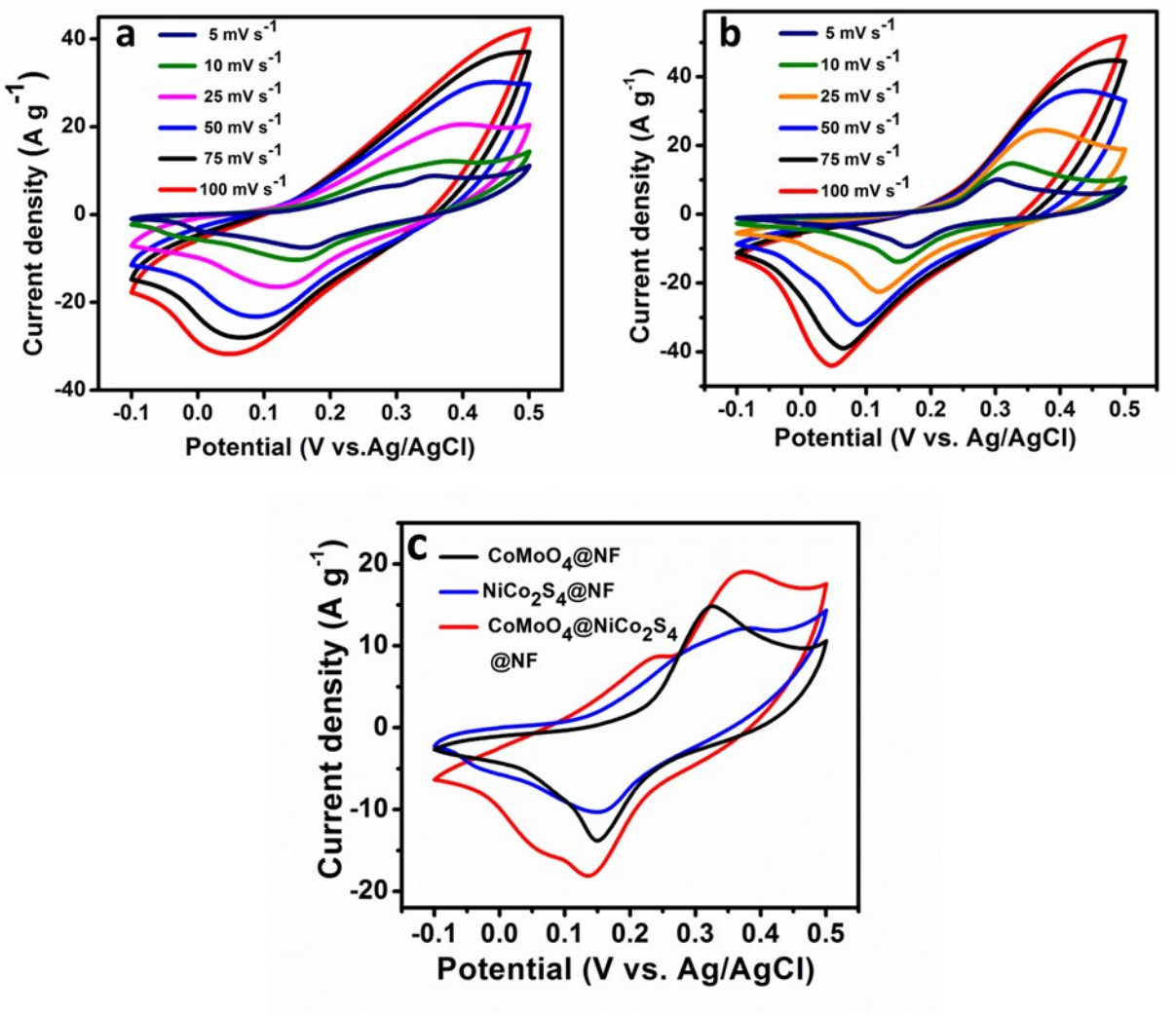

Fig. S7 CV curves of (a) $NiCo_2S_4$@NF and (b) $CoMoO_4$@NF at scan rates in the range of 5 to 100 mV s^{-1} and (c) CV curves based on active masses of electrode materials.

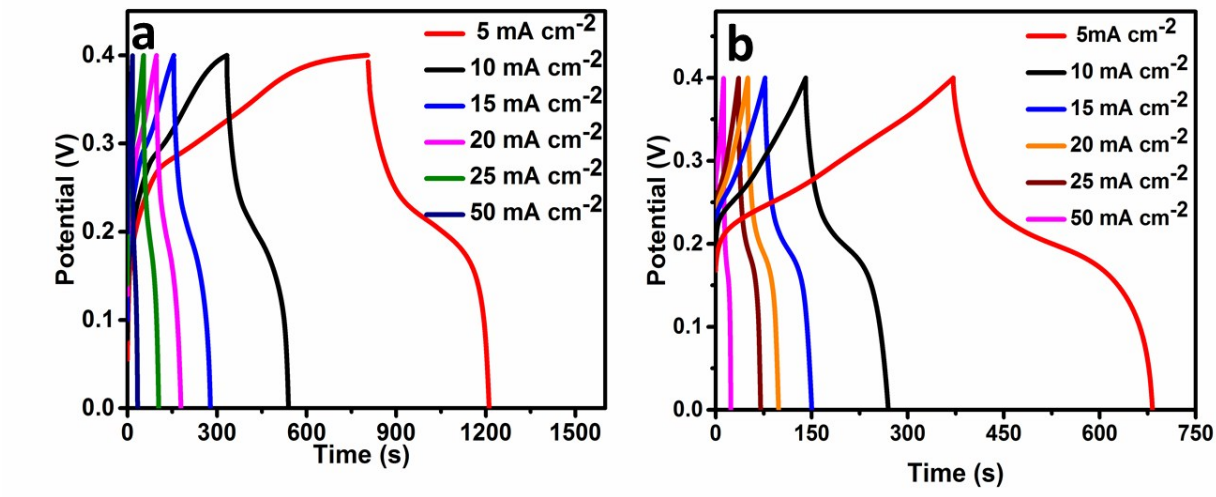

Fig. S8 GCD curves of $NiCo_2S_4$@NF (a) and $CoMoO_4$@NF (b) at current densities in the range of 5 to 10 mA cm^{-1}.

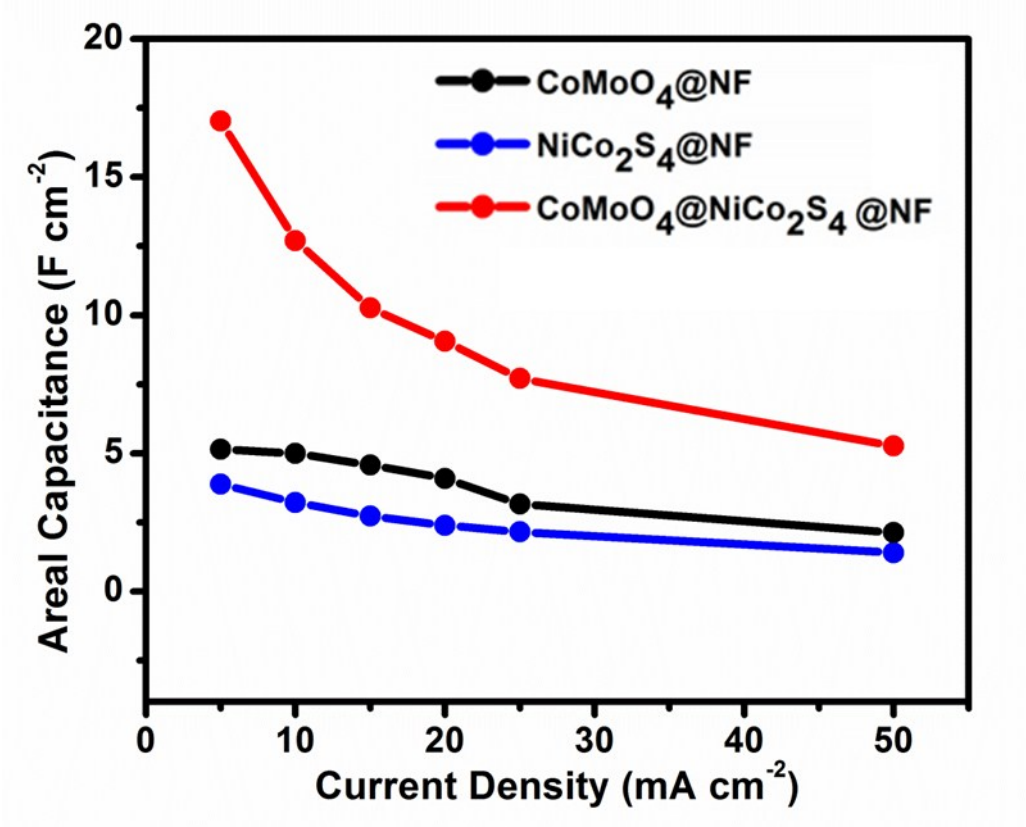

Fig. S9 Areal capacitances of $CoMoO_4$@$NiCo_2S_4$@NF, $NiCo_2S_4$@NF, and $CoMoO_4$@NF at different current densities.

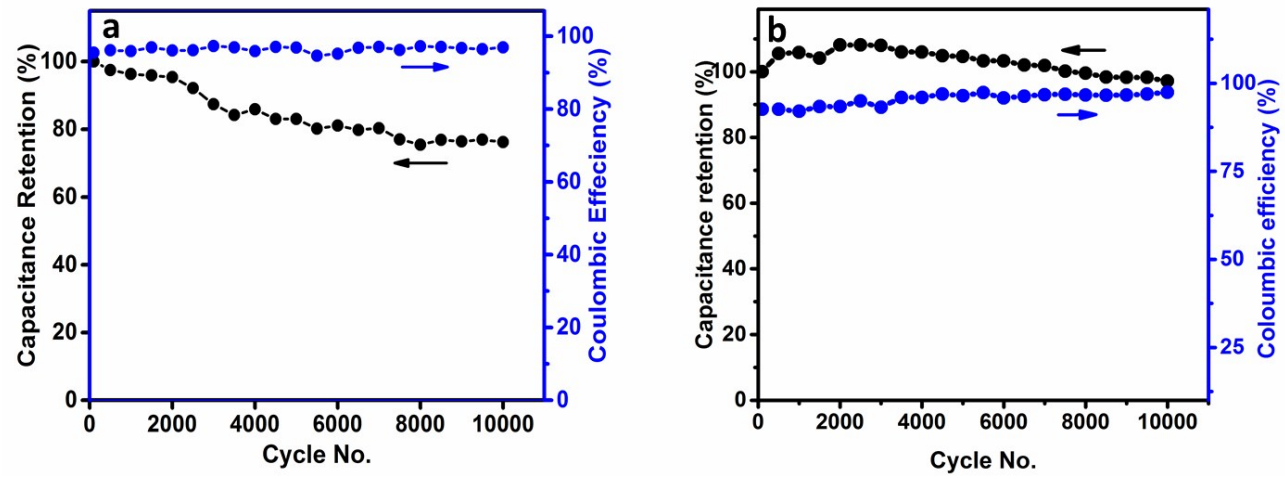

Fig. S10 Capacitance retention and coulombic efficiency of $NiCo_2S_4$@NF (a) and $CoMoO_4$@NF (b) for 10,000 cycles.

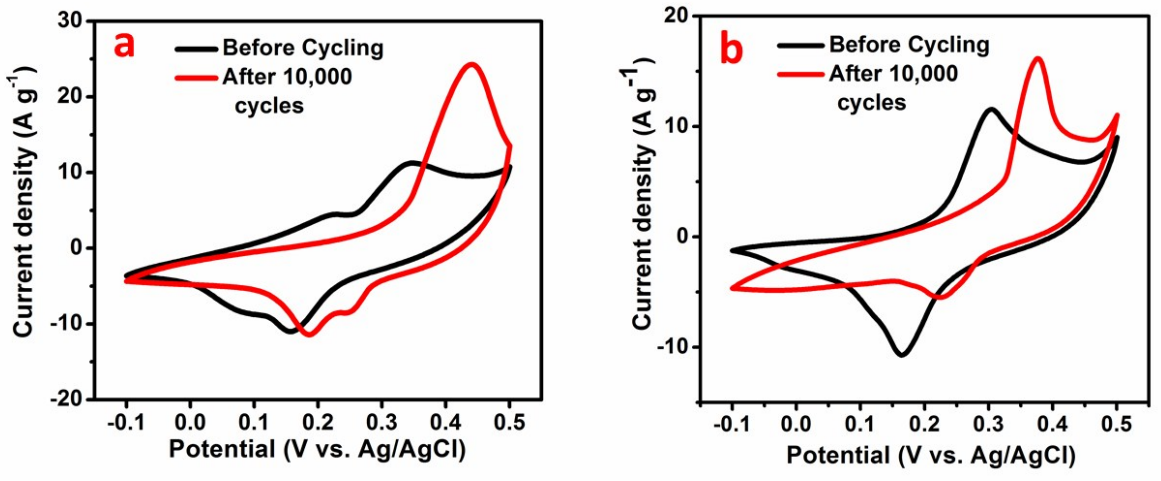

Fig. S11 CV curves of walking palm-like core-shell $CoMoO_4$@$NiCo_2S_4$@NF (a) and $CoMoO_4$@NF (b) before the cycling test and after 10,000 cycles.

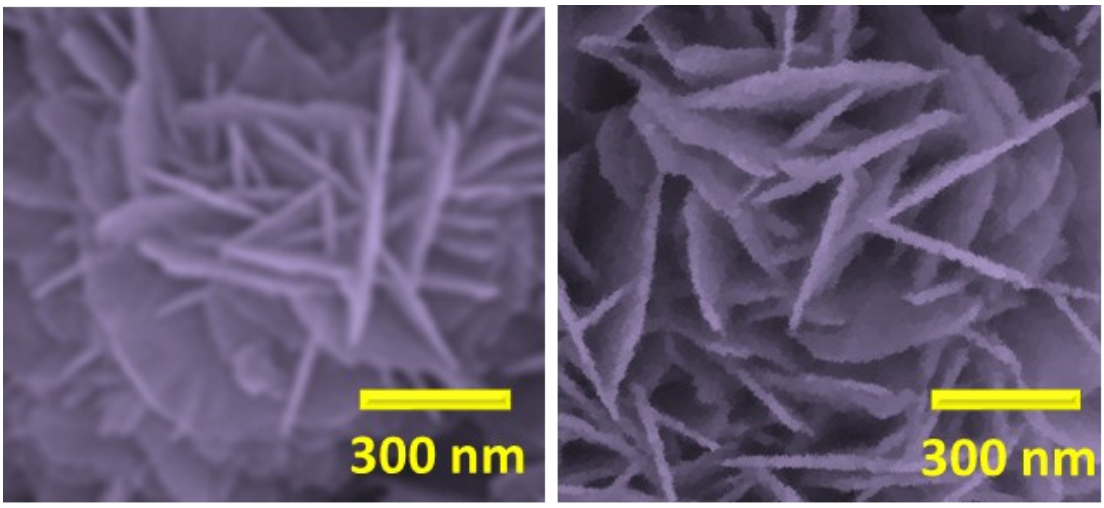

Fig. S12 SEM images of walking palm-like $CoMoO_4$@$NiCo_2S_4$@NF before cycling (a) and after 10,000 cycles (b).

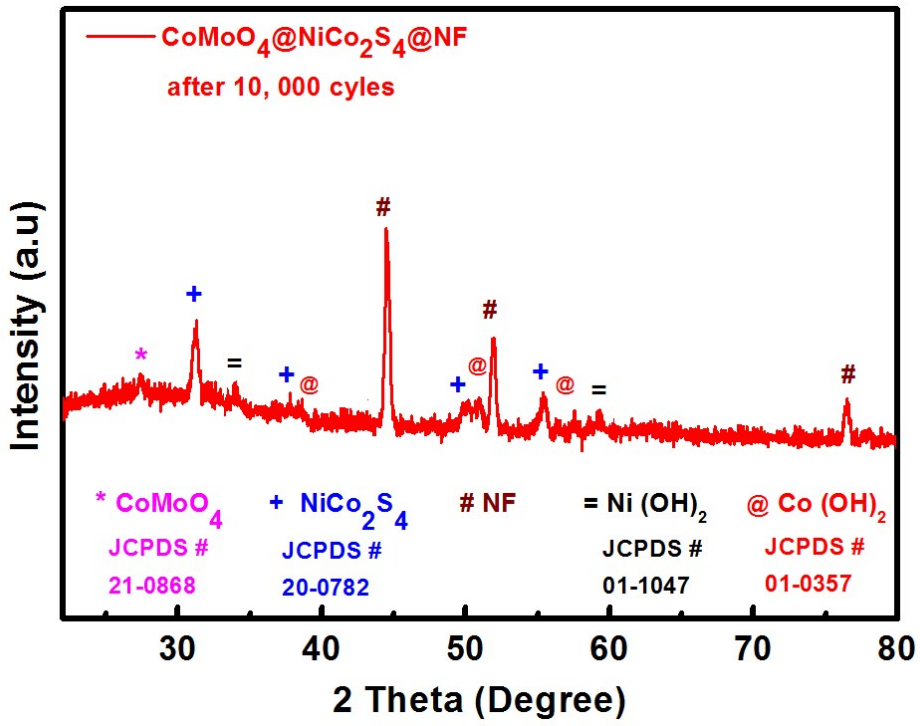

Fig. S13 XRD pattern of walking palm-like core-shell $CoMoO_4$@$NiCo_2S_4$@NF after 10,000 cycles.

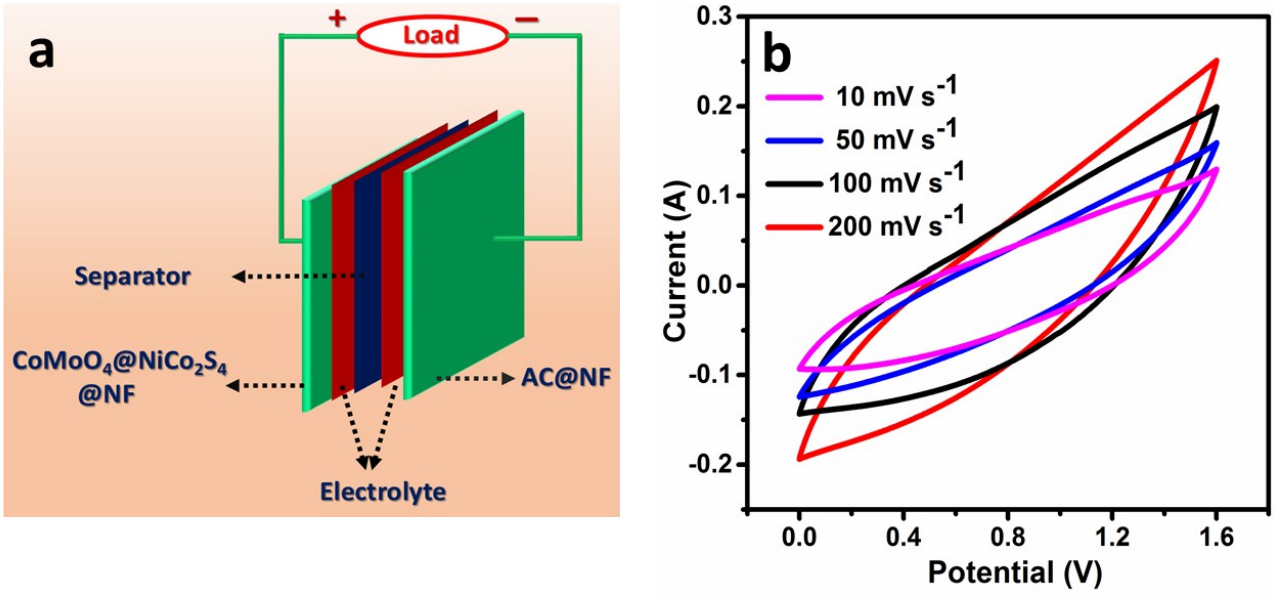

Fig. S14 (a) Schemetic diagram of the fabricated ASC device, (b) CV curves of the ASC device at different scan rates.

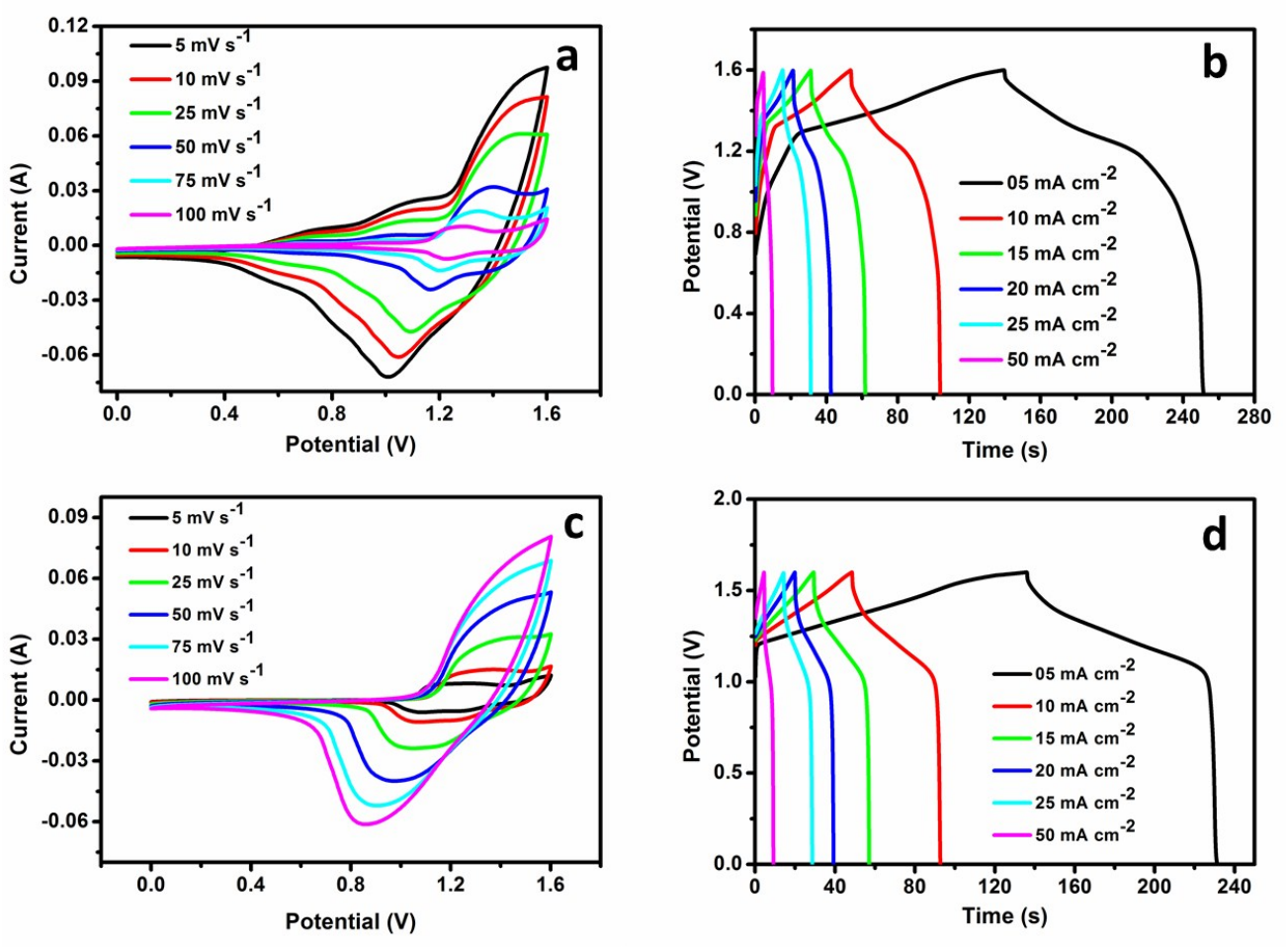

Fig. 15 CV curves at different scan rates (a) and GCD curves at different current densities (b), both for the $NiCo_2S_4$@NF//AC@NF ASC device; CV curves at different scan rates (c) and GCD curves at different current densities (d), both for the $CoMoO_4$@NF//AC@NF ASC device.

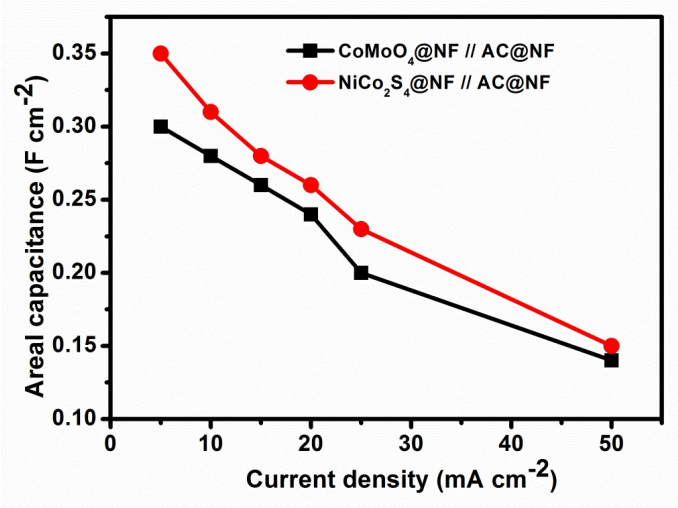

Fig. S16 Areal capacitances of $NiCo_2S_4$@NF//AC@NF and $CoMoO_4$@NF//AC@NF ASC devices at different current densities.

Table S1. Comparison for energy and power densities of different $NiCo_2S_4$ and $CoMoO_4$ asymmetric supercapacitor device

Supercapacitor device	Electrolyte	Potential window (V)	C_a, (F cm^{-2})	ED (Wh kg^{-1})	PD at max ED (kW kg^{-1})	Ref. No.
$NiCo_2S_4$@PPy //AC	3M KOH	0 to 1.6	3.24 at 5 mA cm^{-2}	34.6	0.12	S1
$NiCo_2S_4$@NiO //AC	3M KOH	0 to 1.6	0.59 at 2 mA cm^{-2}	30.3	0.28	S2
$NiCo_2S_4$@PANI // Graphene	6M KOH	0 to 1.6	2.1 at 5 mA cm^{-2}	64.9	0.27	S3
$CoMoO_4$@$NiMoO_4$ //AC	2M KOH	0 to 1.6	NA	28.7	0.26	S4
$NiCo_2S_4$//AC	**3M KOH**	**0 to 1.6**	**0.35 at 5 mA cm^{-2}**	**22.5**	**0.73**	**This work**
$CoMoO_4$//AC	**3M KOH**	**0 to 1.6**	**0.29 at 5 mA cm^{-2}**	**19.0**	**0.72**	**This work**
$CoMoO_4$@$NiCo_2S_4$ //AC	**3M KOH**	**0 to 1.6**	**4.18 at 5 mA cm^{-2}**	**60.2**	**0.18**	**This work**

C_a: Areal capacitance, ED: Energy density, PD: Power density

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S2. Y. Y. Huang, T. L. Shi, S. L. Jiang, S. Y. Cheng, X. X. Tao, Y. Zhong, G. L. Liao and Z. R. Tang, *Sci. Rep-Uk,* 2016, **6.**

S3. Liu, X., Wu, Z., Yin, Y., *Chem. Eng. J.*, 2017, **323,** 330-339.

S4. Z. Q. Zhang, H. D. Zhang, X. Y. Zhang, D. Y. Yu, Y. Ji, Q. S. Sun, Y. Wang and X. Y. Liu, *J. Mater. Chem. A*, 2016, **4**, 18578-18584.