Electronic Supplementary Material (ESI) for Nanoscale.

Supporting Information

Iron Sulphide Rice Grain Nanostructures as Potential Electrocatalysts for Improved Oxygen Evolution Reaction

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Table S1. Comparison of the as-developed FeS nanostructured electrodes in this study and other electrodes reported in the literature.

Materials	**Overpotential (V) at 10 mA cm^{-2}**	**Electrolyte**	**Tafel (mV dec^{-1})**	**Mass activity (A g^{-1})**	**Ref**
$CaFe_{0.5}Co_{0.5}O_3$	0.26	0.1 M KOH	59.0	0.55	1
Fe_2/Co_1-GNCL	0.35	1.0 M KOH	70.0	-	2
Ni-O-G	0.22	1.0 M KOH	42.0	0.46	3
Ni-Fe LDH	0.25 (20 mA cm^{-2})	1.0 M KOH	71.0	-	4
SiW_9Co_3[h]@ZIF-67	0.42	1.0 M KOH	93.9	-	5
$Co_2Mo_3O_8$@NC-800	0.42	1.0 M KOH	87.5	4.1	6
Fe-Co-O	0.26	1.0 M KOH	53.0	-	7
Ag@Co(OH)$_x$	0.25	1.0 M KOH	76.0	-	8
HXP@NC800	0.31	1.0 M KOH	48.0	-	9
FeS-NFS|NF	0.22	1.0 M KOH	64.3	1.6	This study
FeS-NPS|NF	0.30	1.0 M KOH	72.5	3.6	This study
FeS-RGS|NF	0.20	1.0 M KOH	54.2	5.4	This study

GNCL: graphitized nitrogen-doped carbon layer; Ni-O-G: individual nickel (Ni) bonded to oxygen sites on graphene-like carbon; LDH: layered-double-hydroxide; ZIF: zeolitic imidazole frameworks; NC: nitrogen-rich carbon; HXP: 2D nickel-based MOF hexagonal nanoplate; NC: nanocrystal; NFS: nanoflowers; NF: nickel foam; NPS: nanoparticles; RGS: rice grain structures;

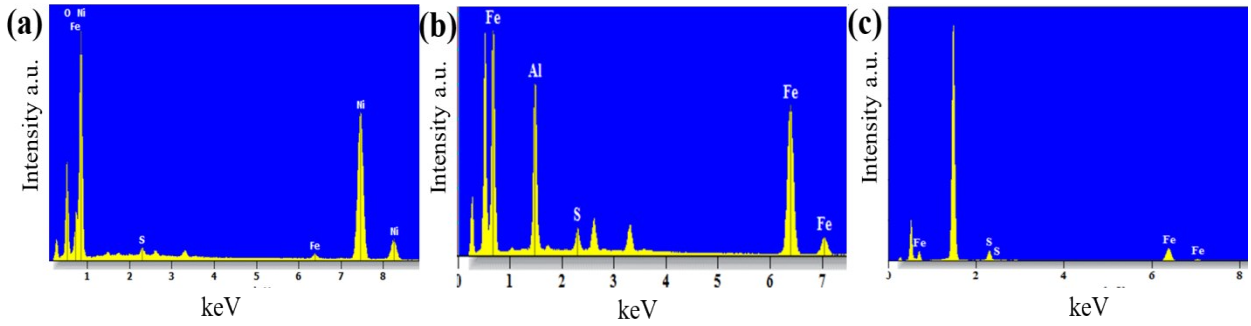

Fig. S1. EDX spectra of FeS-RGS (a), FeS-NFS (b) and FeS-NPS (c) nanomaterials.

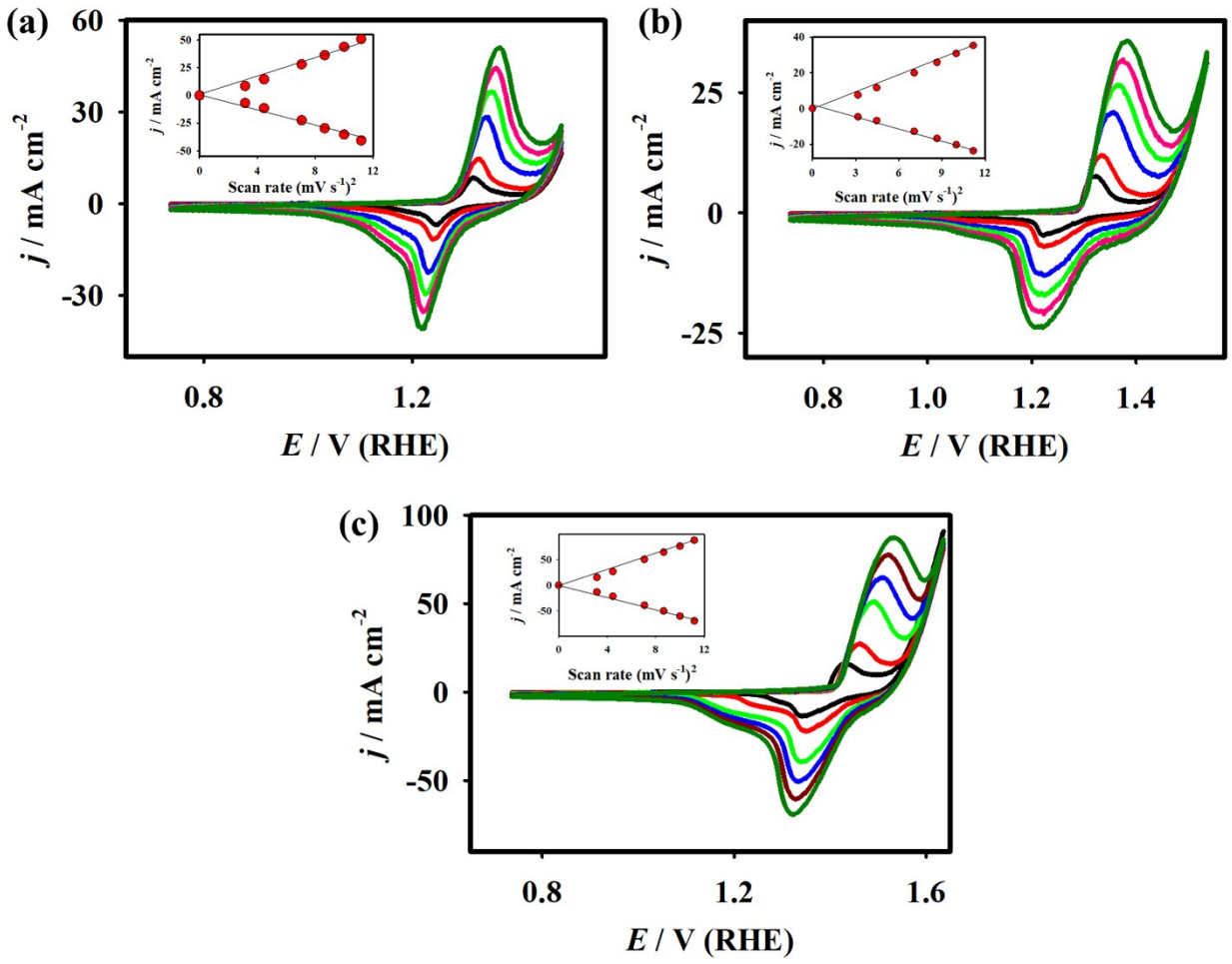

Fig. S2. CV curves of the FeS-RGS|NF (a), FeS-NFS|NF (b) and FeS-NPS|NF (c) electrodes recorded at different scan rates, starting from 10 mVs^{-1} to 125 mVs^{-1}. Inset showing the plot of peak currents vs square root of the scan rates.

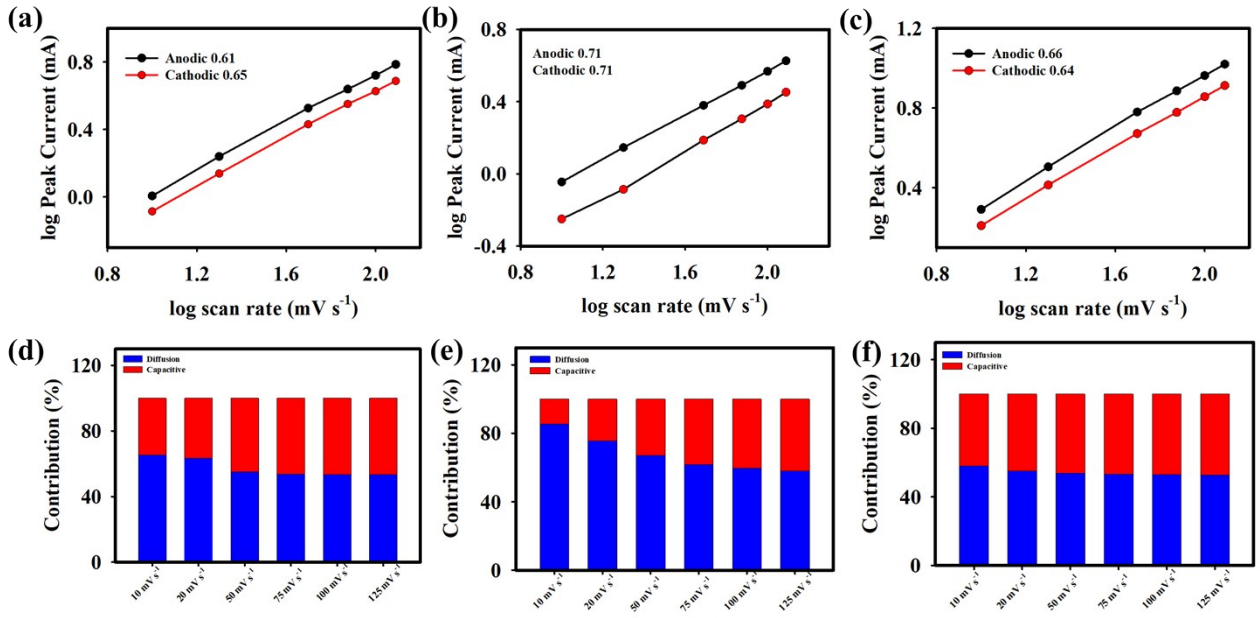

Fig. S3. Plot of logarithm peak current against logarithm scan rate measured for FeS-RGS|NF (a), FeS-NFS|NF (b) and FeS-NPS|NF (c) electrodes, derived from Fig. S2. Contribution ratio between diffusion controlled and capacitance at the FeS-RGS|NF (d), FeS-NFS|NF (e) and FeS-NPS|NF (f) electrodes.

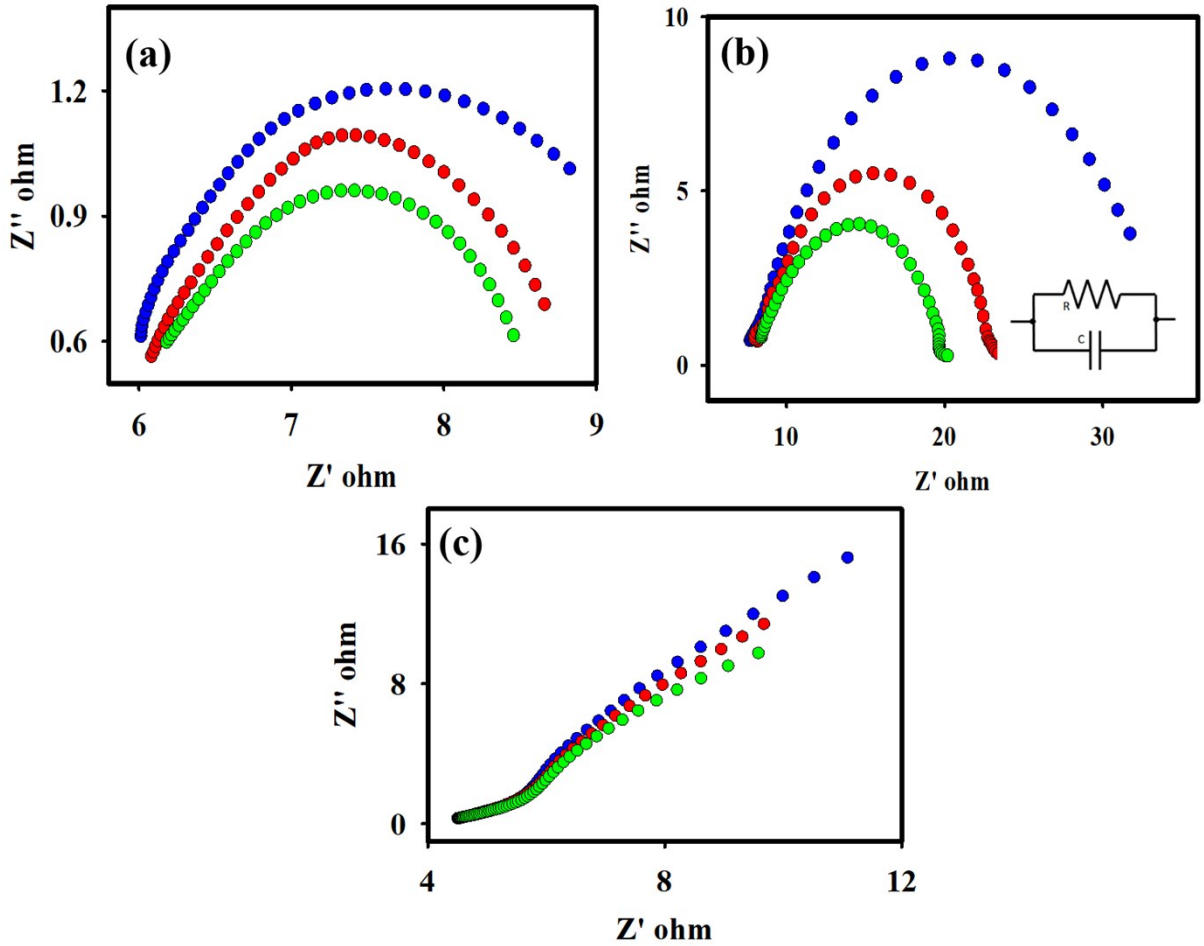

Fig. S4. Nyquist plot of the FeS-RGS|NF (a), FeS-NFS|NF (b) and FeS-NPS|NF (c) electrodes at the applied potential of 1.49 V (blue), 1.51 V (red) and 1.53 V (green) in 1.0 M KOH.

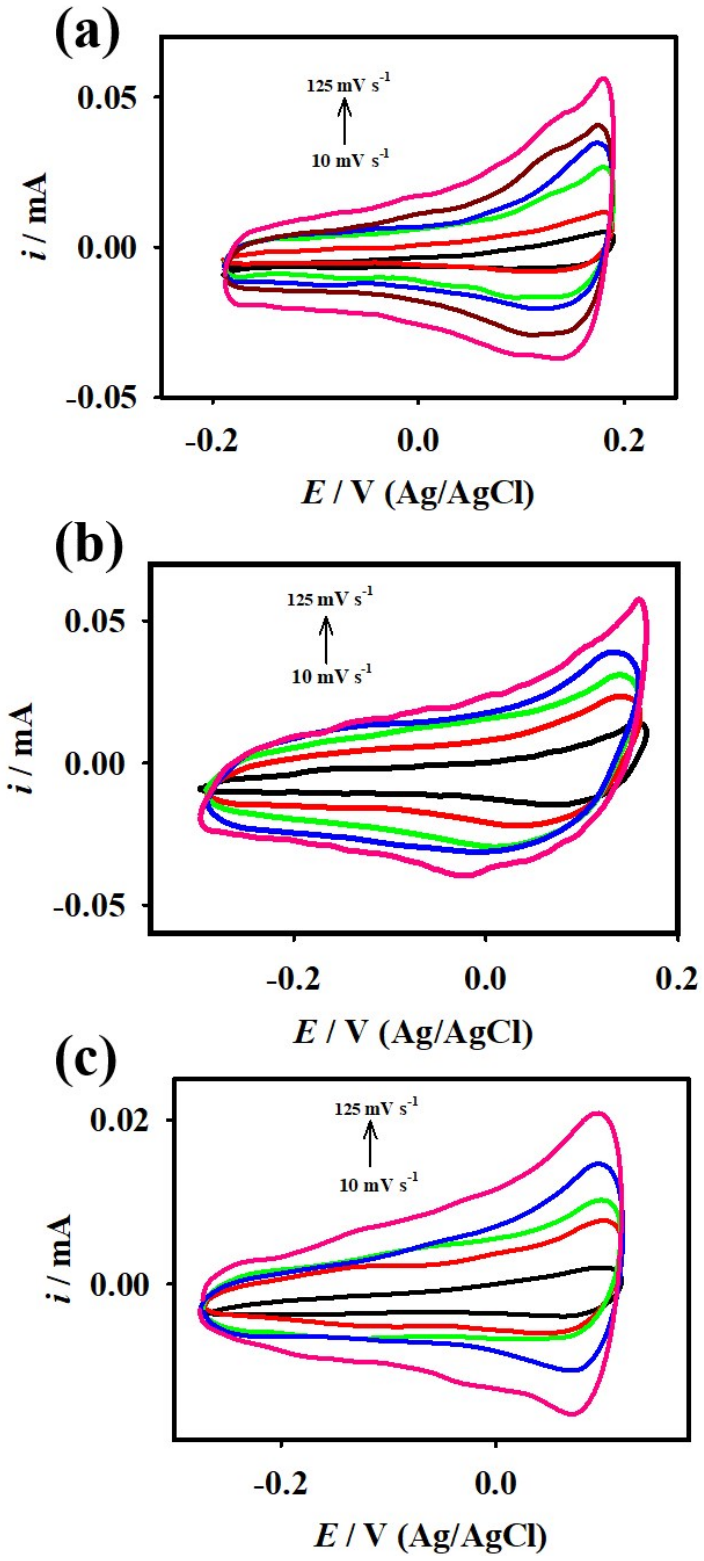

Fig. S5. CV curves of the FeS-RGS|NF (a), FeS-NFS|NF (b) and FeS-NPS|NF (c) electrodes recorded for the electrochemical double layer capacitance measurements at various scan rates.

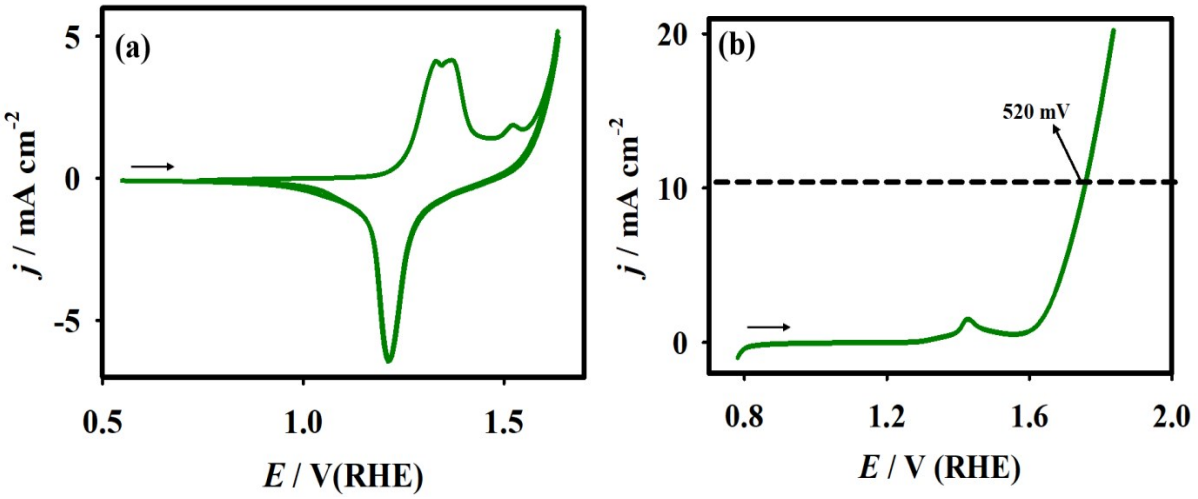

Fig. S6. CV curve (a) and LSV curve (b) of the CoS|NF electrodes recorded in 1.0 M KOH at a scan rate of 20 mV s^{-1}.

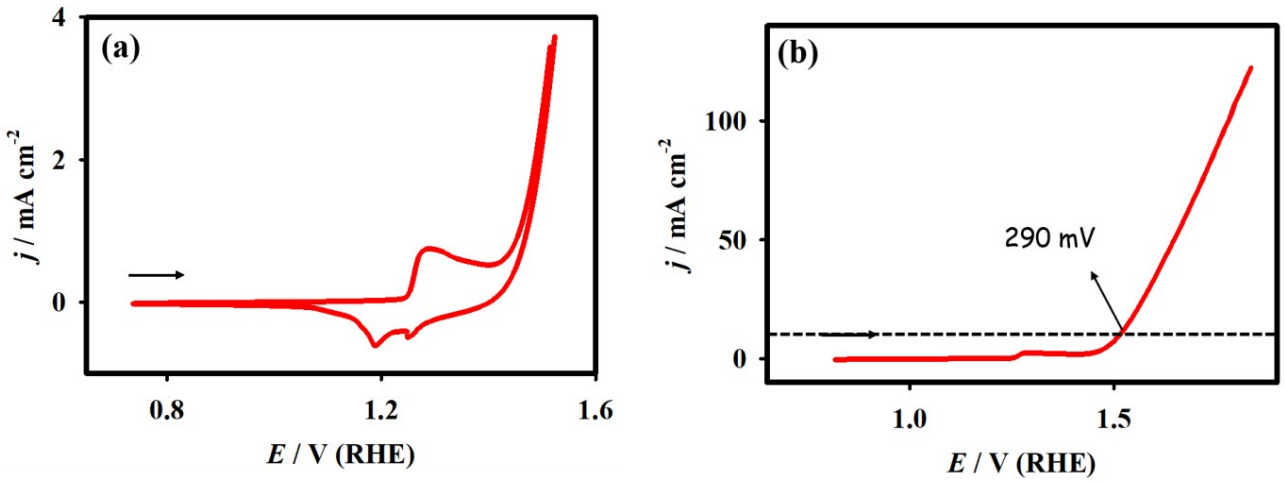

Fig. S7. CV curve (a) and LSV cuve (b) of the FeCoS|NF electrodes recorded in 1.0 M KOH at a scan rate of 20 mV s^{-1}.

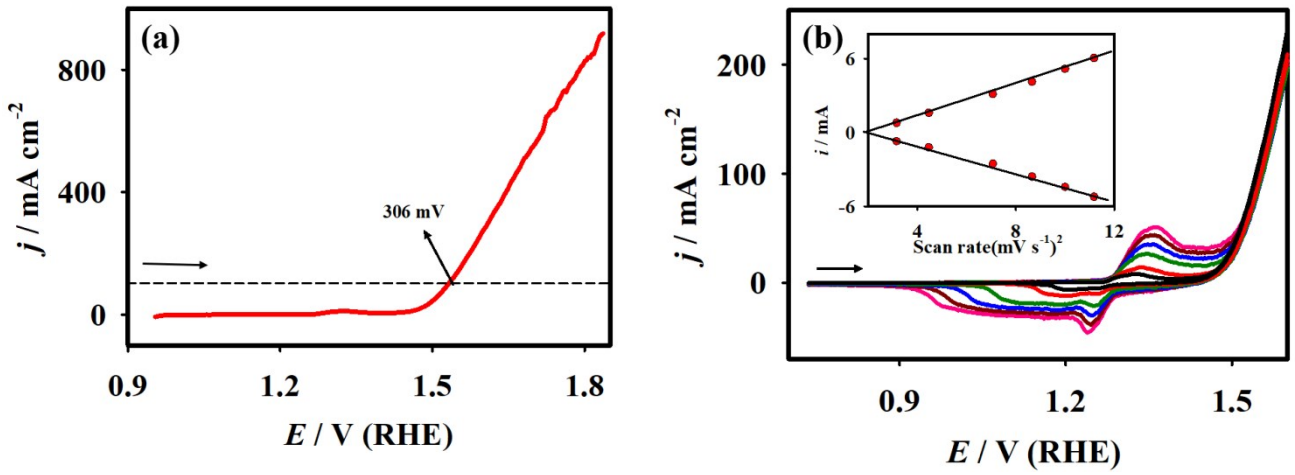

Fig. S8. LSV curve (a) and CV curves (b) of the FeS-RGS|NF electrode recorded in 30% KOH. The inset shows the plot of peak current vs square root of scan rates.

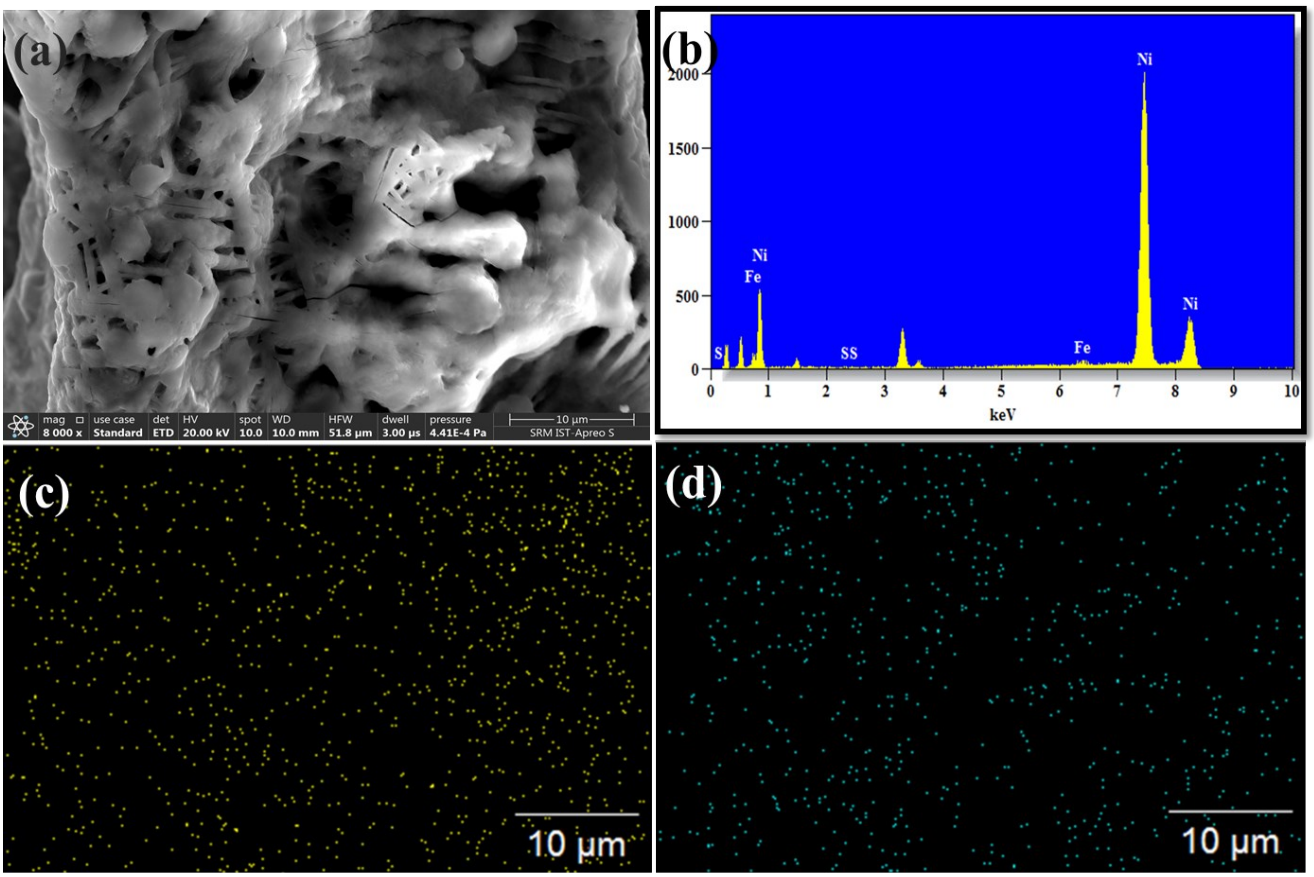

Fig. S9. SEM image (a), EDX spectra (b) and elemental mapping of Fe (c) and S (d) for the FeS-RGS|NF electrode measured after had a long-term stability test.

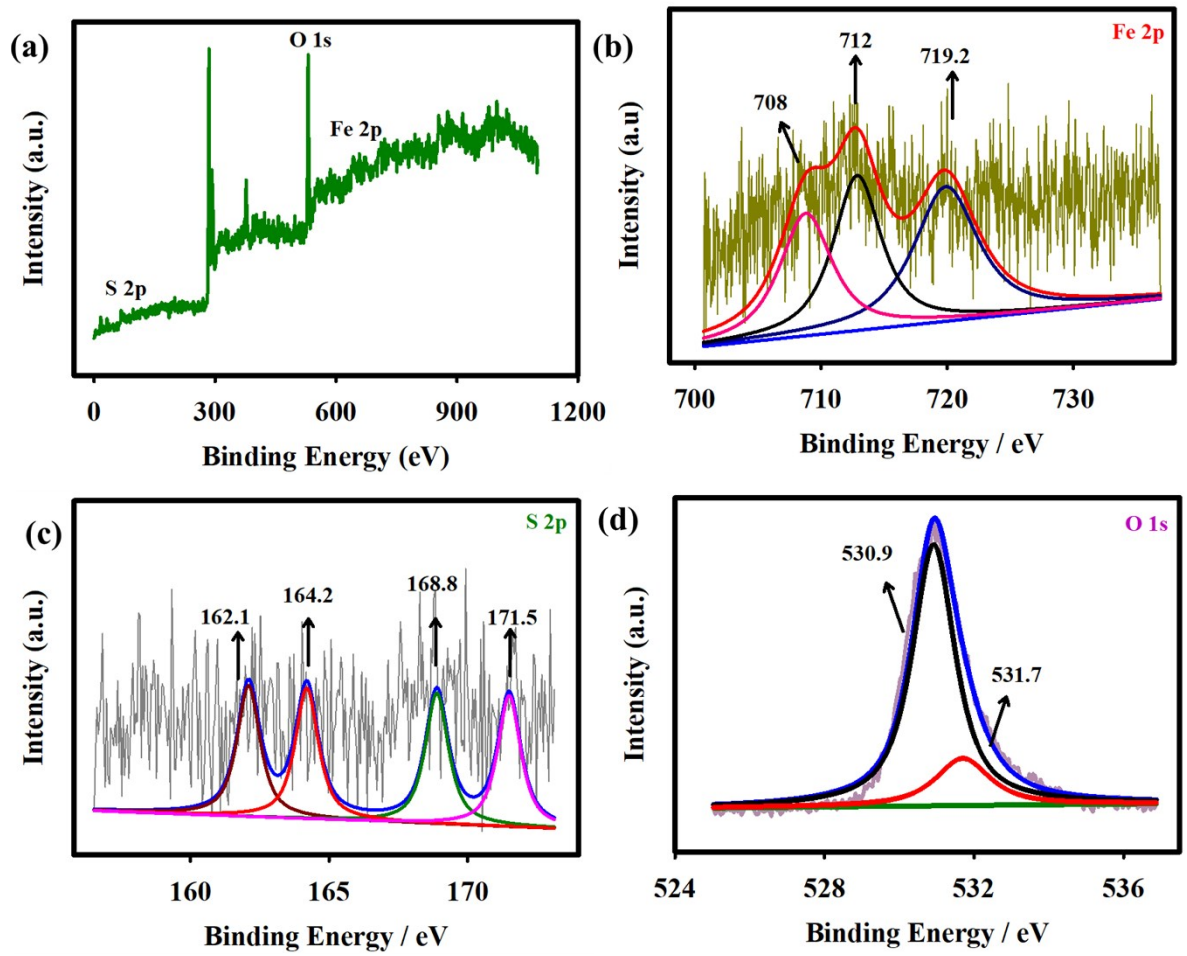

Fig. S10. Full scan XPS analysis of the FeS-RGS|NF electrode after had a long-term durability test (a) and its high resolution XPS spectra in the regions of Fe 2p (b), S 2p (c), and O 1s (d).

References

1 I. Yamada, M. Kinoshita, S. Oda, H. Tsukasaki, S. Kawaguchi, K. Oka, S. Mori, H. Ikeno and S. Yagi, *Chem. Mater.*, 2020, **32**, 3893–3903.

2 Y. S. Wei, L. Sun, M. Wang, J. Hong, L. Zou, H. Liu, Y. Wang, M. Zhang, Z. Liu, Y. Li, S. Horike, K. Suenaga and Q. Xu, *Angew. Chemie - Int. Ed.*, 2020, **59**, 16013–16022.

3 Y. Li, Z. S. Wu, P. Lu, X. Wang, W. Liu, Z. Liu, J. Ma, W. Ren, Z. Jiang and X. Bao, *Adv. Sci.*, 2020, **7**, 1903089.

4 J. Zhang, L. Yu, Y. Chen, X. F. Lu, S. Gao and X. W. (David) Lou, *Adv. Mater.*, 2020, **32**, 1906432.

5 V. K. Abdelkader-Fernández, D. M. Fernandes, S. S. Balula, L. Cunha-Silva and C. Freire, *J. Mater. Chem. A*, 2020, **8**, 13509–13521.

6 T. Ouyang, X. T. Wang, X. Q. Mai, A. N. Chen, Z. Y. Tang and Z. Q. Liu, *Angew. Chemie - Int. Ed.*, 2020, **59**, 11948–11957.

7 Q. Wang, X. Xue, Y. Lei, Y. Wang, Y. Feng, X. Xiong, D. Wang and Y. Li, *Small*, 2020, **16**, 2001571.

8 Z. Zhang, X. Li, C. Zhong, N. Zhao, Y. Deng, X. Han and W. Hu, *Angew. Chemie*, 2020, **132**, 7312–7317.

9 Y. Lin, H. Wan, D. Wu, G. Chen, N. Zhang, X. Liu, J. Li, Y. Cao, G. Qiu and R. Ma, *J. Am. Chem. Soc.*, 2020, **142**, 7317–7321.