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MDPI

Supplementary Materials

Nanostructured Iron Sulfide/N, S Dual-Doped Carbon Nanotube-Graphene Composites as Efficient Electrocatalysts for Oxygen Reduction Reaction

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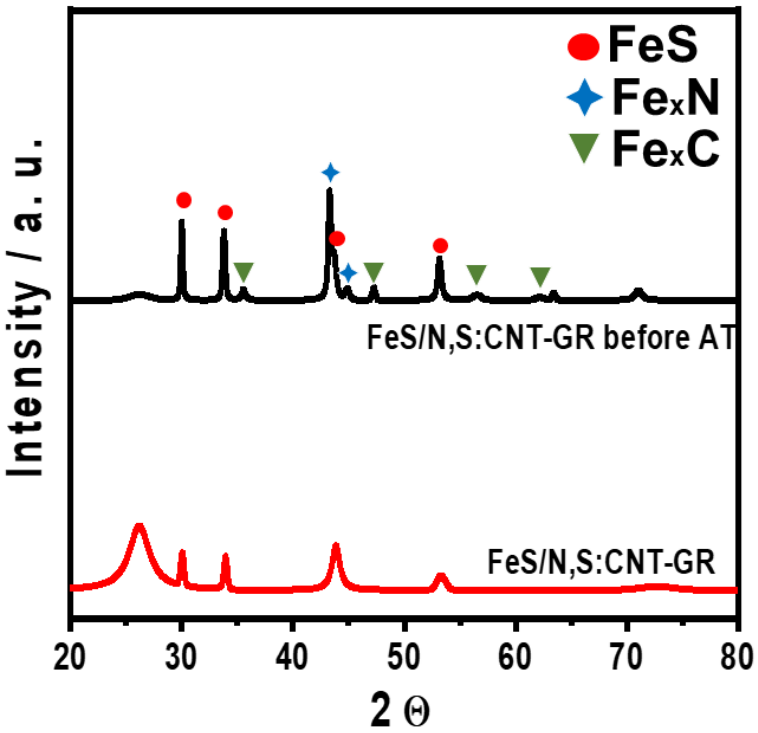

Figure S1. XRD patterns of FeS/N,S:CNT-GR catalyst before and after acid treatment.

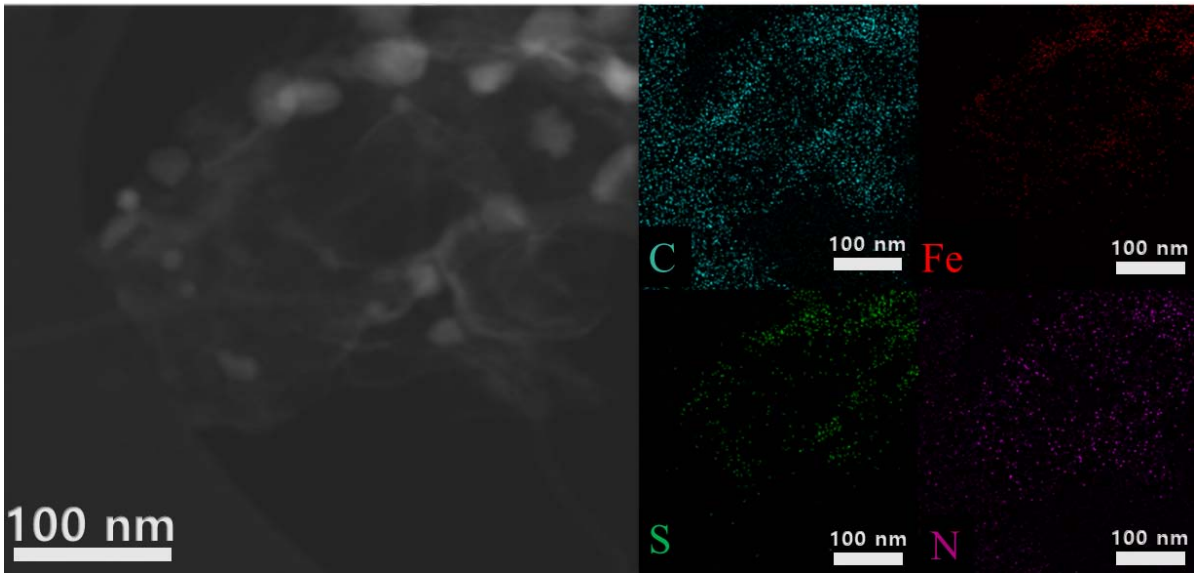

Figure S2. EDS elemental mapping images of FeS/N,S:CNT-GR for C, Fe, S, and N.

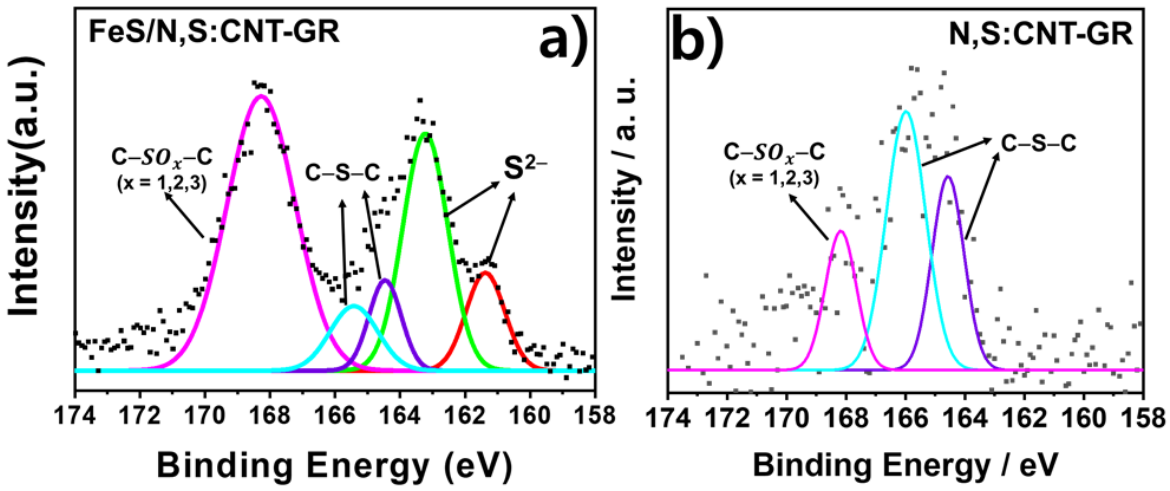

Figure S3. XPS S 2p spectra of (**a**) FeS/N,S:CNT-GR and (**b**) N,S:CNT-GR.

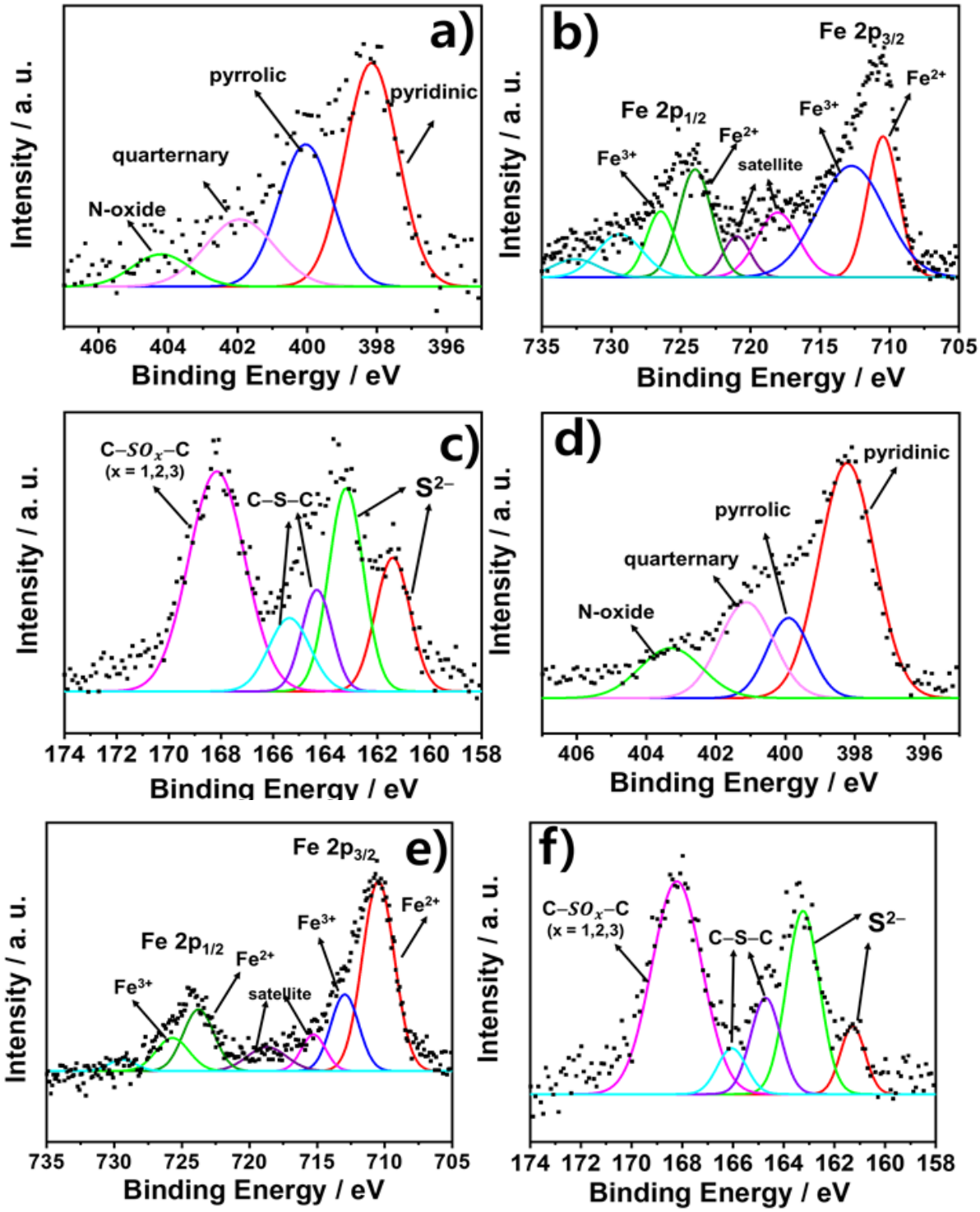

Figure S4. XPS spectra of FeS/N,S:CNT for (**a**) N 1s, (**b**) Fe 2p, and (**c**) S 2p. XPS spectra of FeS/N,S:GR for (**d**) N 1s, (**e**) Fe 2p, and (**f**) S 2p.

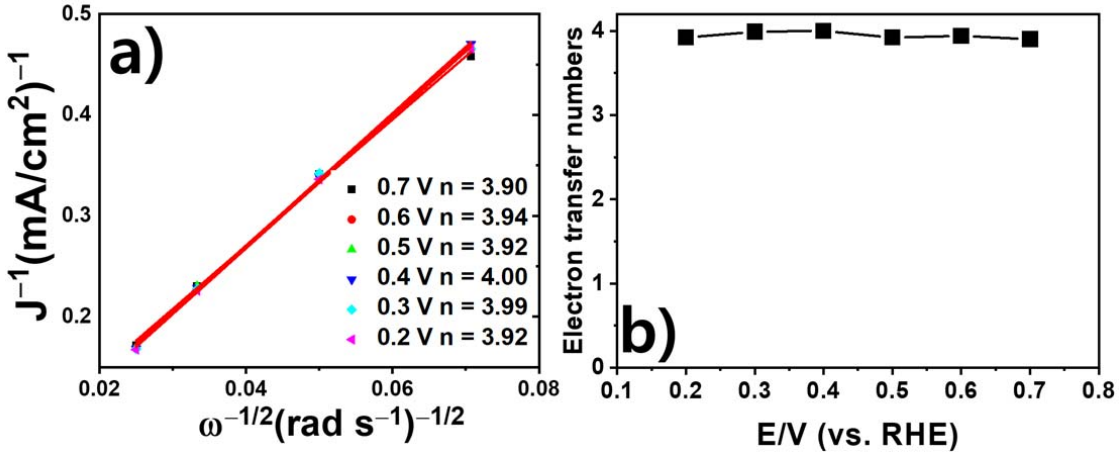

Figure S5. (**a**) Koutecky-Levich plots and (**b**) corresponding electron transfer number of FeS/N,S:CNT-GR at different potentials.

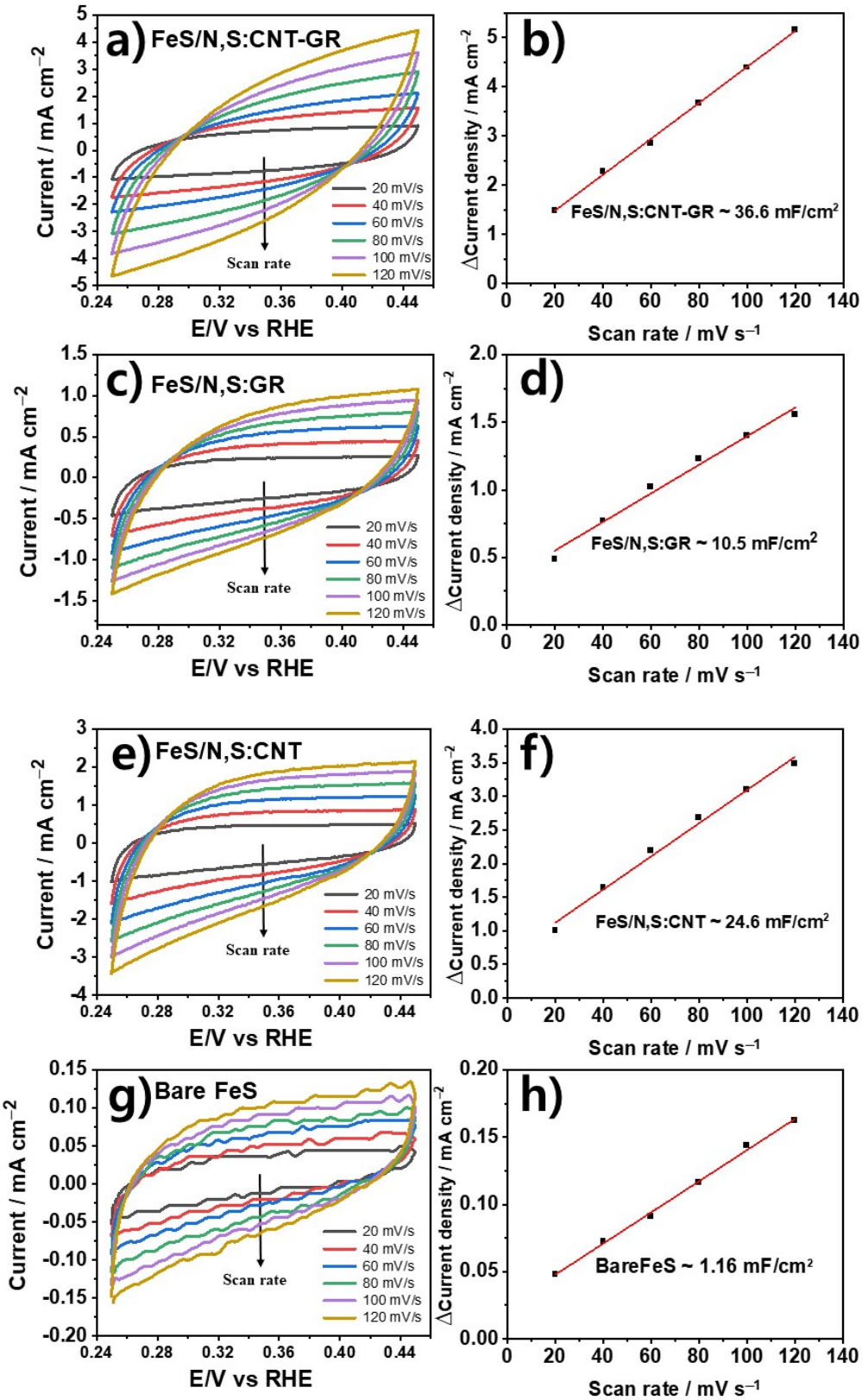

Figure S6. Cyclic voltammograms at different scan rates in N_2-saturated KOH solution and C_{dl} calculation of (**a**,**b**) FeS/N,S:CNT-GR, (**c**,**d**) FeS/N,S:GR, (**e**,**f**) FeS/N,S:CNT, and (**g**,**h**) bare FeS.

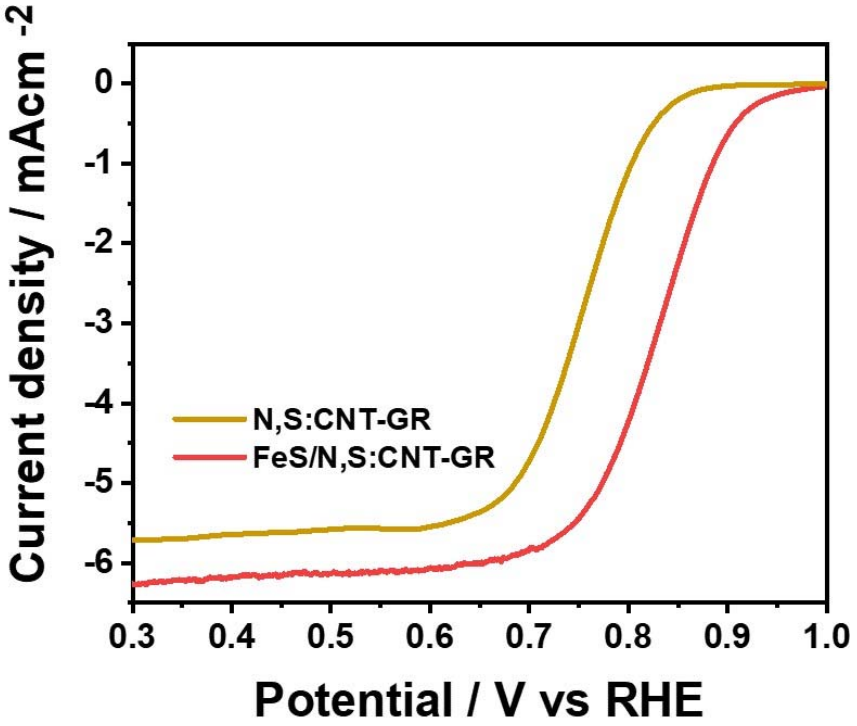

Figure S7. LSV curves of FeS/N,S:CNT-GR and N,S:CNT-GR.

Table S1. Comparison of BET surface area, pore volume, and average pores size of the prepared catalysts with TMS-based electrocatalysts.

Catalysts	BET Surface Areas ($m2 \cdot g^{-1}$)	Pore Volume ($cm^3 \cdot g^{-1}$)	Pore Size (nm)	References
FeS/N,S:CNT-GR	191	0.5568	4	This work
FeS/N,S:CNT	174	0.5067	4	This work
FeS/N,S:GR	137	0.4077	4	This work
FeS/G (Fe:GO = 1:4)	334.15	0.91	4	1
FeS/G (Fe:GO = 1:1)	76.45	0.845	3.5	1
FeS_2-RGO	70.59	-	4	2
ECA-CNS (cobalt nikel sulfide)	71.4	-	-	3
Co_9S_8/N,S-CNS (carbon nanosheet)	22	-	10	4
CoS_2(400)/N,S-GO	19	-	3.5	5

Supplementary References

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Table S2. Comparison of ORR performance in 0.1 M KOH electrolyte of FeS/N,S:CNT-GR with other iron or TMS-based electrocatalysts.

Catalysts	Electrolyte	Onset Potential (vs. RHE)	Half Potential (vs. RHE)	Current Density at 0.3V (mA cm^{-2})	References
FeS/N,S:CNT-GR	0.1 M KOH	0.972	0.827	−6.2	This work
FP-Fe-TA-N-850	0.1 M KOH	0.98	-	−6	1
Fe-N/C	0.1 M KOH	0.923	-	−6	2
Fe-N-CNF	0.1 M KOH	0.93	0.81	−5.12	3
$Fe_{1-x}S$/N,S MGCS	0.1 M KOH	0.97	0.91	−6	4
FeS/G	0.1 M KOH	1.0	0.845	−5	5
$Co_{0.5}Fe_{0.5}S$@N-MC	0.1 M KOH	0.913	0.808	−6	6
Co_9S_8/N,S-CNS	0.1 M KOH	0.90	-	−5	7
CoS NWs@NSC-2	0.1 M KOH	0.93	0.84	-	8

Supplementary References

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