catalysts

Supporting Information: MnS-Nanoparticles-Decorated Three-Dimensional Graphene Hybrid as Highly Efficient Bifunctional Electrocatalyst for Hydrogen Evolution Reaction and Oxygen Reduction Reaction

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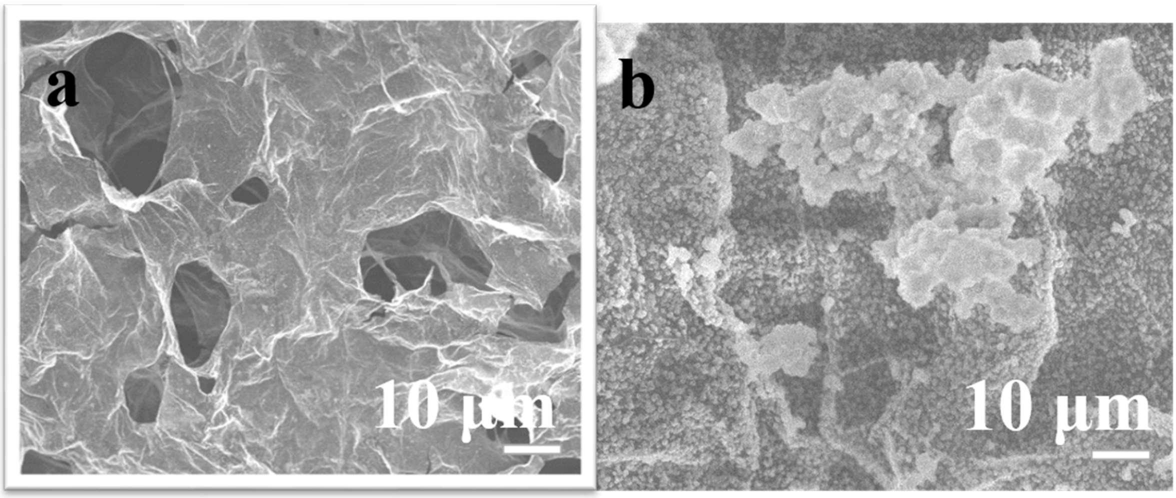

Figure S1. SEM images of SILAR-1 (**a**) and SILAR-10 (**b**).

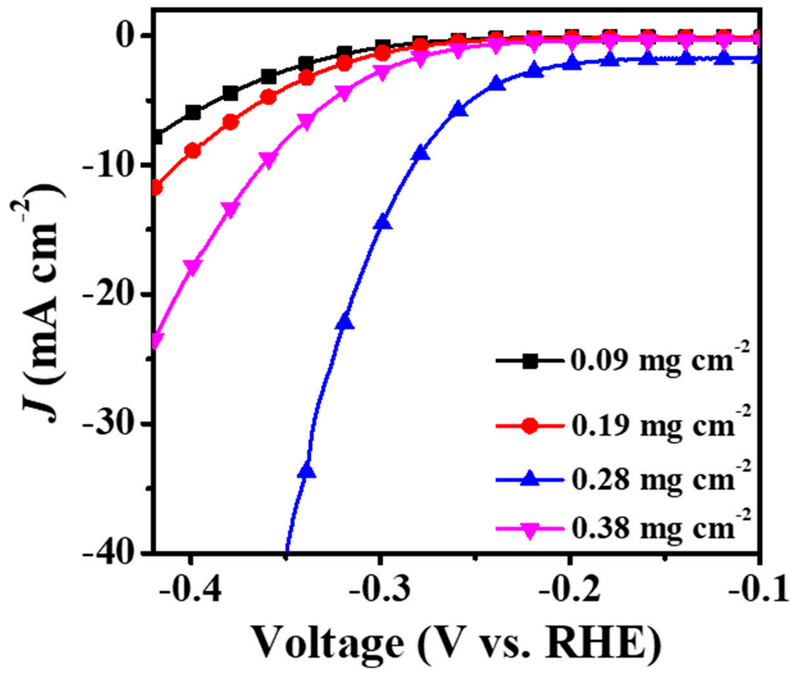

Figure S2. The Polarization curves of MnS-NPs@3DG with different loading weight.

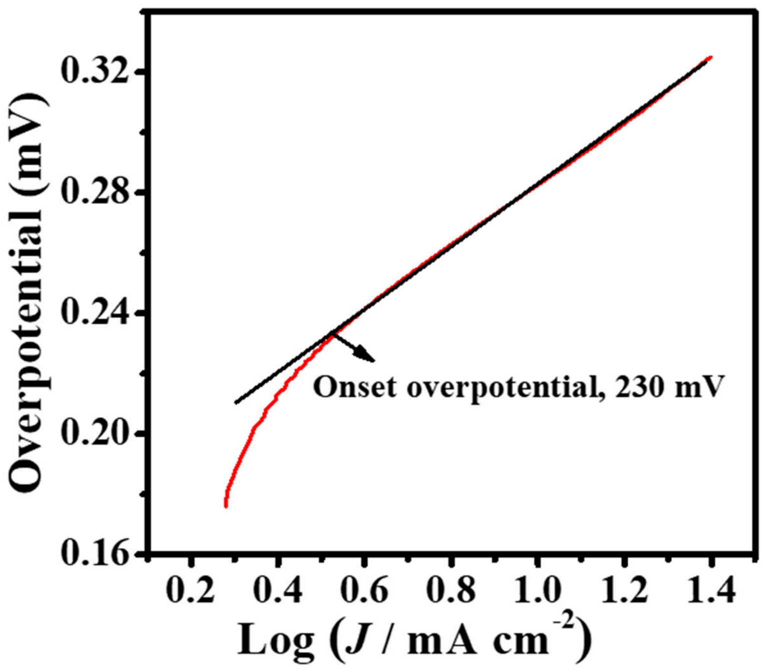

Figure S3. The Tafel plot of the MnS-NPs@3DG.

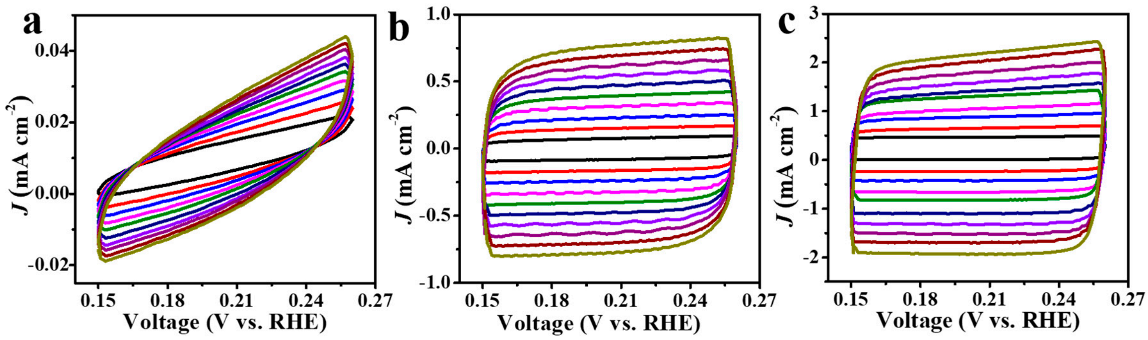

Figure S4. CV curves of bulk MnS (**a**), 3DG (**b**) and MnS-NPs@3DG (**c**) from 0.15 to -0.25 V vs. RHE at different scan rates.

Table S1. Comparison of recently reported highly active Mn-based HER electrocatalyst in the literature.

Electrocatalyst	Electrolyte	Mass loading (mg cm^{-2})	Current density (mA cm^{-2})	Overpotential (V *vs*. RHE)	Tafel slope (mV dec^{-1})	Ref.
MnNi	0.1 M KOH	0.28	10	0.36	N/A	[1]
H-MnO_2-MoS_2 nanohybrids	0.1 M KOH	0.27	10	0.23	66	[2]
$Mn_{0.85}Ni_{15}PS_3$	1 M KOH	1.25	10	0.63	178	[3]
MnO_2/NiO@Ni	1 M KOH	N/A	10	0.23^+	38	[4]
Exf-$MnPS_3$	1 M KOH	0.14	10	1.09	N/A	[5]
Exf-MnPSe3	1 M KOH	0.14	10	0.99	N/A	[5]
MnS-NPs@3DG	0.1 M KOH	0.28	10	0.27	100	This work

Table 2. Comparison of recently reported highly active Mn-based ORR electrocatalyst in the literature.

Electrocatalyst	Electrolyte	Mass loading (mg cm^{-2})	E_{onset} (V *vs*. RHE)	$E_{1.0\ mA\ cm-2}$ (V *vs*. RHE)	$E_{reduction}$ (V *vs*. RHE)	Ref.
MnS-NT/rGO	1.0 M KOH	0.10	1.00	0.94	0.61	[6]
NCNT/$Co_xMn_{1-x}O$	1.0 M KOH	0.21	0.97	0.87	N/A	[7]
Mn_3O_4/C	1.0 M KOH	0.20	$0.92^{a,b}$	$0.82^{a,b}$	0.76^b	[8]
MnO_x/C	1.0 M KOH	0.04	$0.93^{a,b}$	$0.84^{a,b}$	0.56^b	[9]
MnS/S,N-3DG	1.0 M KOH	0.42	0.85^b	$0.69^{a,b}$	0.63^b	[10]
MnS/G (50%)	1.0 M KOH	0.60	0.83	0.74^a	0.6	[11]
MnS-NPs@3DG	0.1 M KOH	0.10	0.9	0.7	0.75	This work

[a] Estimated value: observed values based on the Figures in the article;[b] Potential conversion of $E_{vs\ (different\ reference\ electrodes)}$ to $E_{vs.\ RHE}$ were shown in Table S2; E_{onset}: Onset potential of the electrocatalysts for ORR; $E_{1.0\ mA\ cm-2}$: Polarization potential of the electrocatalysts at 1.0 mA cm^{-2} for ORR; $E_{reduction}$: Reduction potential of the electrocatalyst for ORR.

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