Electronic Supplementary Information

Template-free hydrothermal synthesis of nickel sulfide nanocrystals on MWCNTs: Efficient and stable bifunctional electroactive material for oxygen electrocatalysis†

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A)			Spectrum 2 B)			
	С			Element	Weight %	Atomic %
	0			С	79.57	83.84
30 m Brf = 200 k/ Signa A = 251 Det (3 A = 2019	<u>.</u>		····	0	20.43	16.16
C)	1 2 3 4 5 6 Full Scale 737 cts Cursor: 0.000	7 8 9 10	11 12 keV	Element	Weight %	Atomic %
	0		-,	СК	47.44	62.95
	Çe Ni 🍦	Ni		O K	30.70	30.58
		Ni Ni		S K	2.36	1.17
200 mm BH1 ≈ 20.00 kV Signa A ≈ 261 Date 5 Date 2019 21333 WD ≈ 10.0 mm Mag ≈ 50.00 KX Time 2117.15	1 2 3 4 5 6 Full Scale 389 cts Cursor: 0.000	7 8 9 10	11 12 ke∨	Ni K	19.50	5.29
E)			F)	Element	Weight %	Atomic %
E)	o s		F)	Element C	Weight % 35.49	Atomic % 52.04
E)	S S S	Nie	F)	Element C O	Weight % 35.49 33.72	Atomic % 52.04 37.13
E)	o s c Ni	Ni Ni	F)	Element C O S	Weight % 35.49 33.72 6.39	Atomic % 52.04 37.13 3.51
B M ²	O S C Ni 1 2 3 4 5 6 Full Scale 389 cts Cursor: 0.000	Ni Ni 7 8 9 10	F)	Element C O S Ni	Weight % 35.49 33.72 6.39 24.40	Atomic % 52.04 37.13 3.51 7.32
E) ^{Mem} Pr-38m Park Park Park Park Park Park Park Park	S C Ni 1 2 3 5 6 Ful Scale 389 cts Cursor: 0.000	Ni Ni 7 8 9 10	F)	Element C O S Ni Element	Weight % 35.49 33.72 6.39 24.40 Weight %	Atomic % 52.04 37.13 3.51 7.32 Atomic %
E)	Ni Scale 389 cts Cursor: 0.000	Ni Ni 7 8 9 10	F)	Element C O S Ni Element C	Weight % 35.49 33.72 6.39 24.40 Weight % 28.92	Atomic % 52.04 37.13 3.51 7.32 Atomic % 46.64
E)	S C Ni 1 2 3 4 5 6 Full Scale 389 cts Cursor: 0.000	Ni Ni 7 8 9 10	F)	Element C O S Ni Element C O	Weight % 35.49 33.72 6.39 24.40 Weight % 28.92 31.95	Atomic % 52.04 37.13 3.51 7.32 Atomic % 46.64 38.67
E) Met Bradew	Ni Science State S	Ni 7 8 9 10	F)	Element C O S Ni Element C O S	Weight % 35.49 33.72 6.39 24.40 Weight % 28.92 31.95 6.52	Atomic % 52.04 37.13 3.51 7.32 Atomic % 46.64 38.67 3.94

Fig. S1 SEM (A, C, E, and G), EDAX (B, D, F, and H), and elemental composition of MWCNTs (A and B), NiS-(0.1)@MWCNTs (C and D), NiS-(0.5)@MWCNTs (E and F), and NiS (1.0)@MWCNTs (G and H).



Fig. S2 FESEM images of A) MWCNTs, B) NiS-(0.1)@MWCNTs, C) NiS-(0.5)@MWCNTs, and D) NiS-(1.0)@MWCNTs



Fig. S3 HR-TEM images of A) MWCNTs, B) NiS-(0.1)@MWCNTs, C) NiS-(0.5)@MWCNTs, and D) NiS-(1.0)@MWCNTs. Inset shows the SAED pattern of the same.



Fig. S4 A) LSV curves representing the mass activity of a) MWCNTs, b) NiS-(0.1)@MWCNTs, c) NiS-(0.5)@MWCNTs, d) NiS-(1.0)@MWCNTs, e) Ni-S@MWCNTs-500, and f) RuO₂.

B) Bar graph showing the mass activity at 1.6 V vs. RHE.



Fig. S5 A) Tafel slope for a) GC/NiS-(0.1)@MWCNTs, b) GC/NiS-(0.5)@MWCNTs,c) GC/NiS-(1.0)@MWCNTs, d) GC/ Ni-S@MWCNT-500, and e) RuO₂.

B) Bar diagram of the Tafel slope values for the respective electrodes.



Fig. S6 A) Tafel slope of a) MWCNTs, b) NiS(0.1)@MWCNTs, c) NiS(0.5)@MWCNTs, d) NiS(1.0)@MWCNTs, e) Ni-S@MWCNTs-500, and f) Pt-C (20%), and B) bar diagram depicting the value of Tafel slopes of the corresponding material.



Fig. S7 CV responses (A, C, E, and G) at different scan rates in the non-faradaic region and the plot of scan rate vs. current density (B, D, F, and H) for NiS-(0.1)@MWCNTs (A and B), NiS-(0.5)@MWCNTs (C and D), NiS-(1.0)@MWCNTs (E and F), and Ni-S@MWCNTs-500 (G and H).



Fig. S8 The LSV responses before and after the 5000 continuous CV cycles at A) Ni-S@MWCNTs-500 and B) Pt-C (20%) in O₂ saturated environment.



Fig. S9 The 1000 continuous CV cycles recorded at Ni-S@MWCNTs-500 in 1.0 M KOH at the scan rate of 300 mVs⁻¹.



Fig. S10 XRD patterns of Ni-S@MWCNTs-500 coated on an ITO glass plate, before and after the OER catalysis.



Fig. S11 A) XPS survey spectra of Ni-S@MWCNTs-500 after the OER catalysis, with high-resolution scan for B) C 1s, C) O 1s, D) Ni 2p,

and E) S 2p together with the respective de-convoluted spectra.