Supporting Information

FeS Nanosheets Assembled with 1T-MoS_2 Nanoflowers on Iron Foam for Efficient Overall Water Splitting

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1. Experimental

1.1 Materials: All chemicals were used without further purification (analytical grade). Thioacetamide (CH_3CSNH_2) and sodium molybdate dihydrate ($Na_2MoO_4·2H_2O$, 99%) were purchased from Shanghai Aladdin Biochemical Technology Co.Ltd (Shanghai, China) and Sinopharm Chemical Reagent Co. Ltd (Shanghai, China).

1.2 Treatment of the Fe foam: A piece of IF (20 mm × 25 mm) was washed with 1 mol/L HCl, acetone, 75% alcohol, and deionized water for several times to clear the surface impurities, and dried at 60 °C for 6 h in vacuum.

1.3 Materials Characterization: X-ray diffraction (XRD) patterns were obtained on a MAC Science MXP-18 X-ray diffractometer utilizing a Cu target radiation source. Transmission electron micrographs (TEM), high-resolution transmission electron micrographs (HRTEM) images were acquired on JEM-2100 electron microscope with the accelerating voltage of 200 kV. The scanning electron microscope (SEM) images, the elemental mappings and energy dispersive X-ray spectroscopy (EDAX) images were obtained on JEOLJ SM-7800F at 10.0 kV. The surface chemistry and the binding energy of different electronic states of the samples were examined by XPS with a Thermo ESCALAB 250Xi.

1.4 Electrochemical Characterization: HER/OER electrochemical performance tests were performed with a CHI 760E electrochemical workstation (Chenhua Corp., Shanghai) in a standard three-electrode system at ambient temperature, of which the graphite rod was used as the counter electrode, the Hg/HgO electrode was worked as the reference electrode and the FMSx sample (cutting into pieces of 0.3×0.3 cm^2) was acted as the working electrode. In the two-electrode cell system, the as-prepared $FMS_{0.5}$ was served as cathode and anode respectively for overall water splitting. For comparison, 1T-MoS_2 was dropped on IF for testing, which named as 1T-MoS_2/IF. The electrolyte was 1.0 M KOH (pH = 13.6) for all the electrochemical tests. Before the electrochemical experiments, the electrolyte was previously degassed with N_2 for 30 min. All the potentials were converted to potentials versus the reversible hydrogen electrode (RHE) by using the following equation:

$$E_{RHE} = E_{SCE} + 0.098 + 0.059 \times PH$$

Linear sweep voltammetry (LSV) curves were tested at a scan rate of 5 mV s^{-1} to obtain the polarization curves, which were steady-state after several cycles. All measured polarization curves were iR-corrected. For comparison, commercial Pt/C or RuO_2 were also prepared as working electrodes. In a typical process, 20 mg of the commercial Pt/C (20 wt%) (or RuO_2) powder was dispersed in a mixture of 60 μl of nafion solution (1wt %) and 540 μl of isopropanol solution, which was sonicated for 30 minutes. Then 8 μl of the above solution was dropped on a piece of cleaned IF foam (0.3 cm × 0.3 cm, catalysts loading ≈ 3 mg cm^{-2}). The cycle durability was measured by the chronoamperometric response. Electrochemical impedance spectroscopy (EIS) measurements were carried out at frequency ranging from 0.1 to 10^4 Hz.

2. Supplementary Results

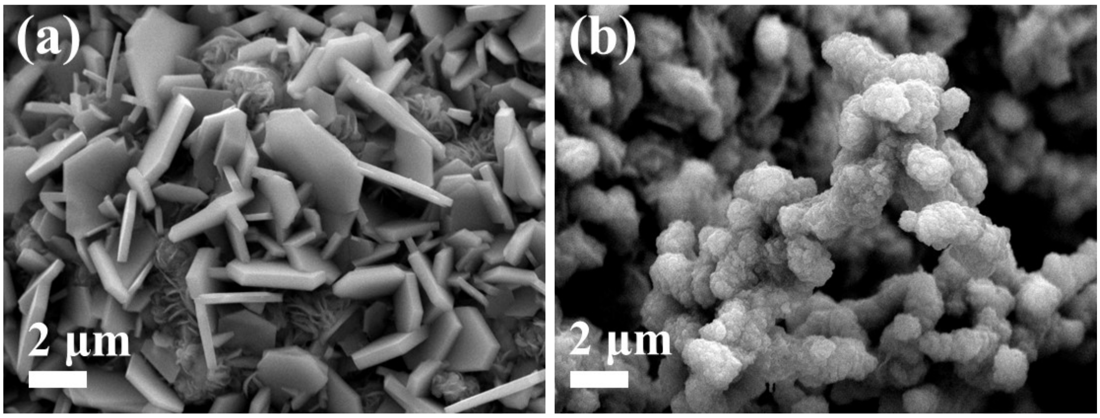

Fig. S1 SEM images of FMS 0.1(a) and FMS 0.9(b)

Table S1. Comparison of HER performance of FMS 0.5 with reported electrocatalysts

Electrolyte	Catalyst	Overpotential (mV)	Current density (mA/cm^2)	Tafel slope (mV/dec^2)	ref
1 M KOH	FeS/Ni_3S_2@NF	130	10	124	[1]
1 M KOH	CoS_2/FeS-MOF@NF-1	137	10	80	[2]
1 M KOH	MoS_2@Fe/Ni-MOF_{600}-3	140	10	158	[3]
1 M KOH	Ni-1T MoS_2	199	10	52.7	[4]
1 M KOH	TEA-1T MoS_2	355	10	70	[5]
1 M KOH	$CT_{0.5}$-G1	312	10	85	[6]
1 M KOH	1T/2H MoS_2 (25D) /$Ti_3C_2T_{x-1}$	300	10	117.2	[7]
1 M KOH	1T MoS_2/GO	209	10	71.7	[8]
1 M KOH	rGO/1T-MoS_2/CeO_2	140	10	43	[9]
1 M KOH	FMS 0.5	245	100	80.6	This work

Table S2. Comparison of OER performance of FMS 0.5 with reported electrocatalysts

Electrolyte	Catalyst	Overpotential (mV)	Current density (mA/cm^2)	Tafel slope (mV/dec^2)	ref
1 M KOH	FeS/Ni_3S_2@NF	192	10	70	[1]
1 M KOH	CoS_2/FeS-MOF@NF-1	244	50	27	[2]
1 M KOH	MoS_2@Fe/Ni-MOF_{600}-3	340	10	158	[3]
1 M KOH	Ni-1T MoS_2	310	10	103.2	[4]
1 M KOH	FeS/Fe_3C@N-S-C-800	570	10	81	[10]
1 M KOH	1T-$Ni_{0.2}Mo_{0.8}S_{1.8}P_{0.2}$ NS/CC	305	40	76.5	[11]
1 M KOH	0.2-A@NF	190	10	166	[12]
1 M KOH	NiFe LDH/MoS_2	190	10	31	[13]
1 M KOH	$NiFe_2O_4/MoS_2$	280	10	48.7	[14]
1 M KOH	MoS_2/NiS_2/CC-2	384	100	58	[15]
1 M KOH	FMS 0.5	316	100	88.3	This work

Table S3.The charge transfer resistance of IF, FeS, 1T-MoS_2/IF and FMSx

Samples	**IF**	**FeS**	**1T MoS_2/IF**	**FMS0.1**	**FMS0.5**	**FMS0.9**
$R_{ct}(\Omega)$ HER	1.92	1.1	1.43	0.9	0.72	0.93
$R_{ct}(\Omega)$ OER	1.15	1	0.98	0.7	0.65	0.71

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