

Supplementary Information

Highly Dispersed Pt Nanoparticles on 2D MoS₂ Nanosheets for Efficient and Stable Hydrogen Evolution Reaction

Yaru Li, Shuaiqi Wang, Youdi Hu, Xiaoze Zhou, Meng Zhang, Xiaoyu Jia, Yi Yang,
Bo-Lin Lin and Gang Chen*

School of Physical Science and Technology, ShanghaiTech University, Shanghai
201210, China

*E-mail: gchen@shanghaitech.edu.cn

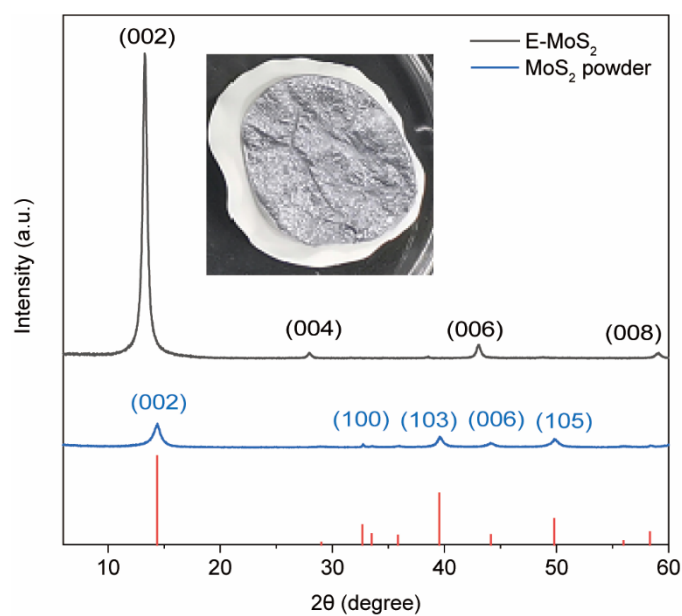


Fig. S1 XRD pattern of the E-MoS₂ film obtained by vacuum filtration and the MoS₂ powder. Inset: the digital picture of the E-MoS₂ film.

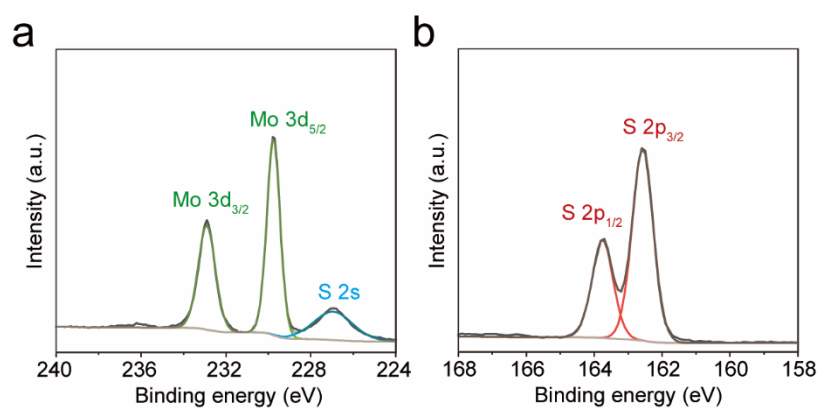


Fig. S2 (a) XPS spectra of Mo 3d and S 2s for E-MoS₂. (b) XPS spectra of S 3p for E-MoS₂.

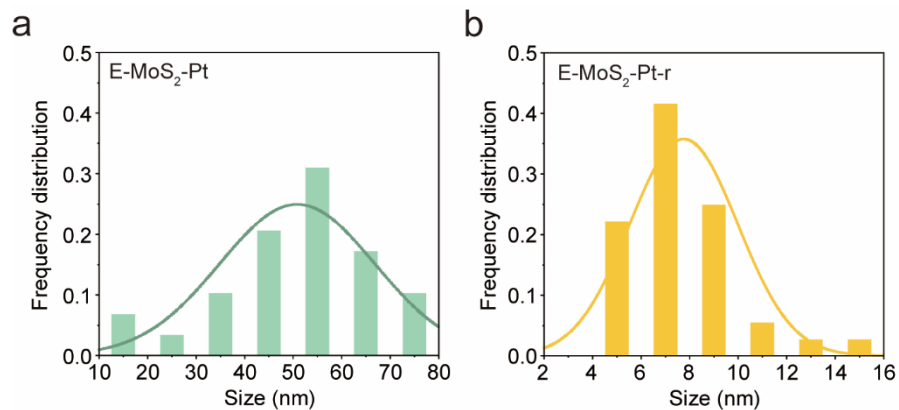


Fig. S3 (a) The size distribution of the Pt NPs on E-MoS₂-Pt. (b) The size distribution of the Pt NPs on E-MoS₂-Pt-r.

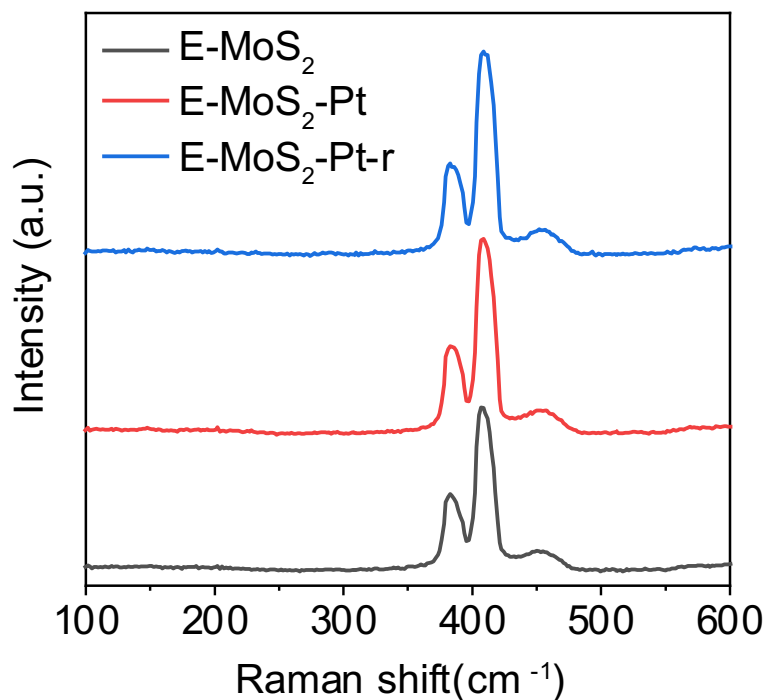


Fig. S4 Raman spectra of E-MoS₂, E-MoS₂-Pt and E-MoS₂-Pt-r.

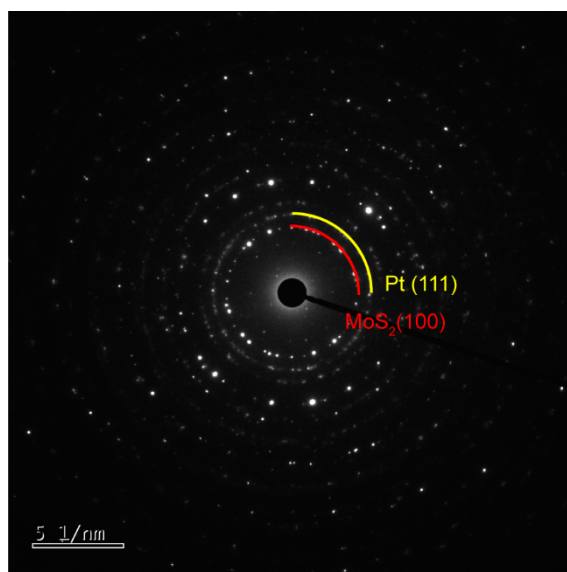


Fig. S5 The selected area electron diffraction (SAED) pattern of E-MoS₂-Pt. The marked red diffraction ring corresponds to the lattice spacing of $d = 0.27$ nm for MoS₂ (100) and the yellow ring corresponds to $d = 0.22$ nm for Pt (111).

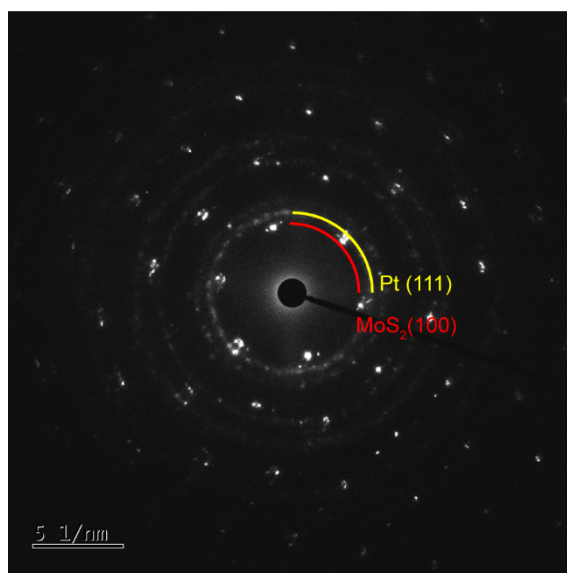


Fig. S6 The SAED pattern of E-MoS₂-Pt-r. The marked red diffraction ring corresponds to the lattice spacing of $d = 0.27$ nm for MoS₂ (100) and the yellow ring corresponds to $d = 0.22$ nm for Pt (111).

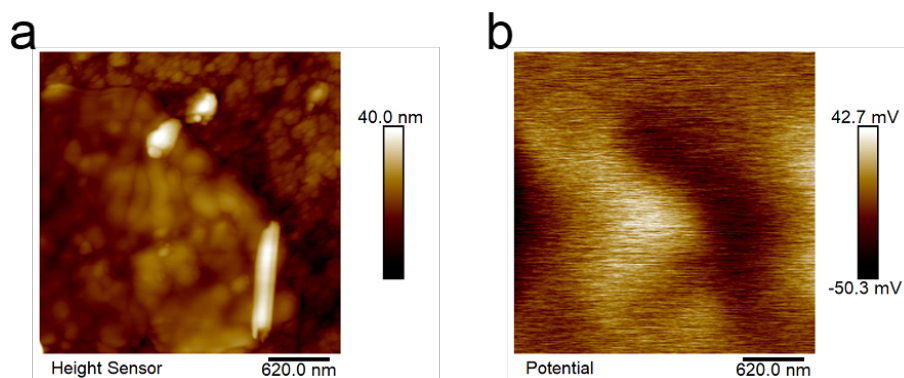


Fig. S7 (a) Atomic force microscope (AFM) image of the E-MoS₂ nanosheet. (b) The corresponding Kelvin probe force microscopy (KPFM) image of the E-MoS₂ nanosheet.

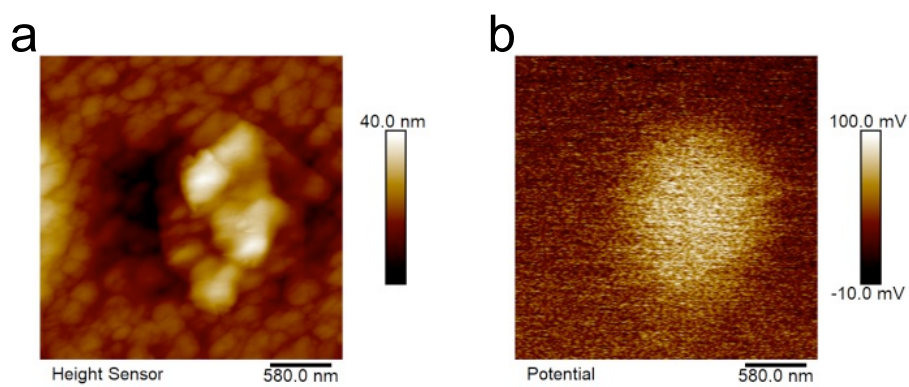


Fig. S8 (a) AFM image of E-MoS₂-Pt nanosheets. (b) The corresponding KPFM image of the E-MoS₂-Pt nanosheet.

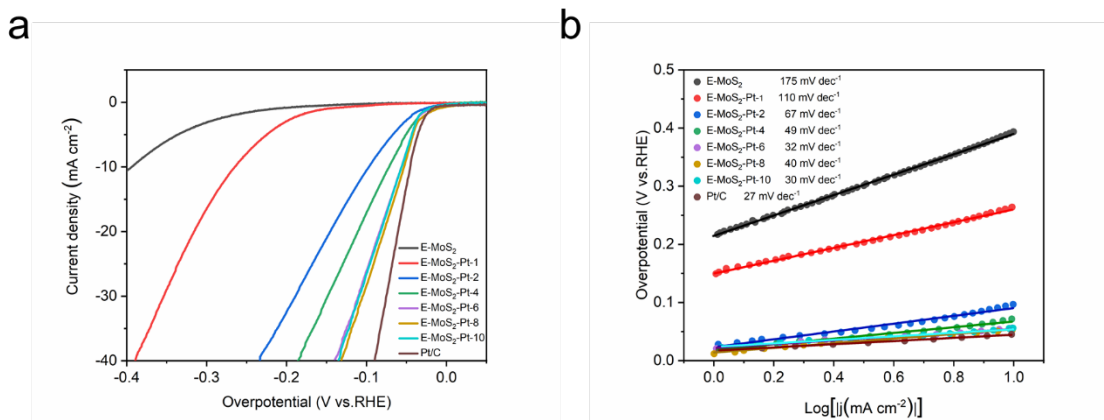


Fig. S9 (a) The polarization curves of E-MoS₂, the commercial Pt/C (20 wt%) and E-MoS₂-Pt for the Pt mass ratios of 0.01 (E-MoS₂-Pt-1), 0.02 (E-MoS₂-Pt-2), 0.04 (E-MoS₂-Pt-4), 0.06 (E-MoS₂-Pt-6), 0.08 (E-MoS₂-Pt-8) and 0.1 (E-MoS₂-Pt-10) in the 0.5 M H₂SO₄ solution. (b) The corresponding Tafel pots derived from (a).

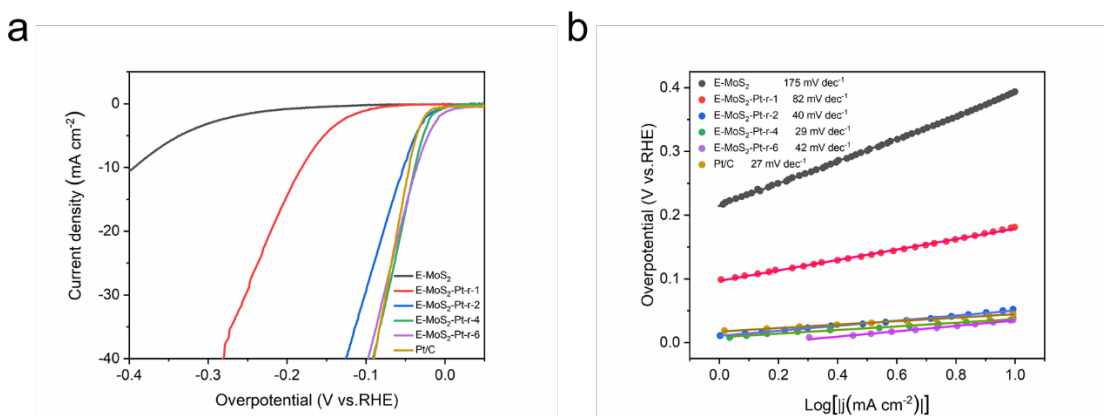


Fig. S10 (a) The polarization curves of E-MoS₂, the commercial Pt/C (20 wt%) and E-MoS₂-Pt-r for the Pt mass ratios of 0.01 (E-MoS₂-Pt-r-1), 0.02 (E-MoS₂-Pt-r-2), 0.04 (E-MoS₂-Pt-r-4) and 0.06 (E-MoS₂-Pt-r-6) in the 0.5 M H₂SO₄ solution. (b) The corresponding Tafel plots derived from (a).

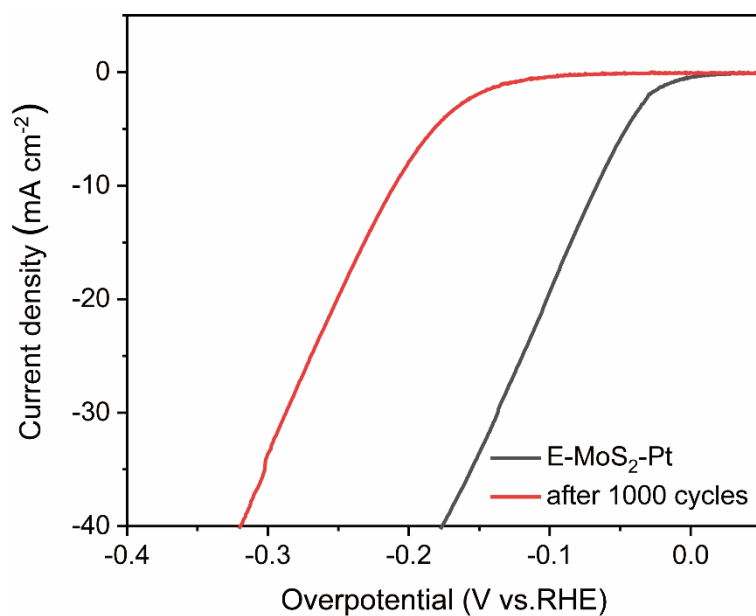


Fig. S11 The polarization curves of E-MoS₂-Pt taken initially and after 1000 cycles (from -0.1 V to -0.3 V vs. RHE).

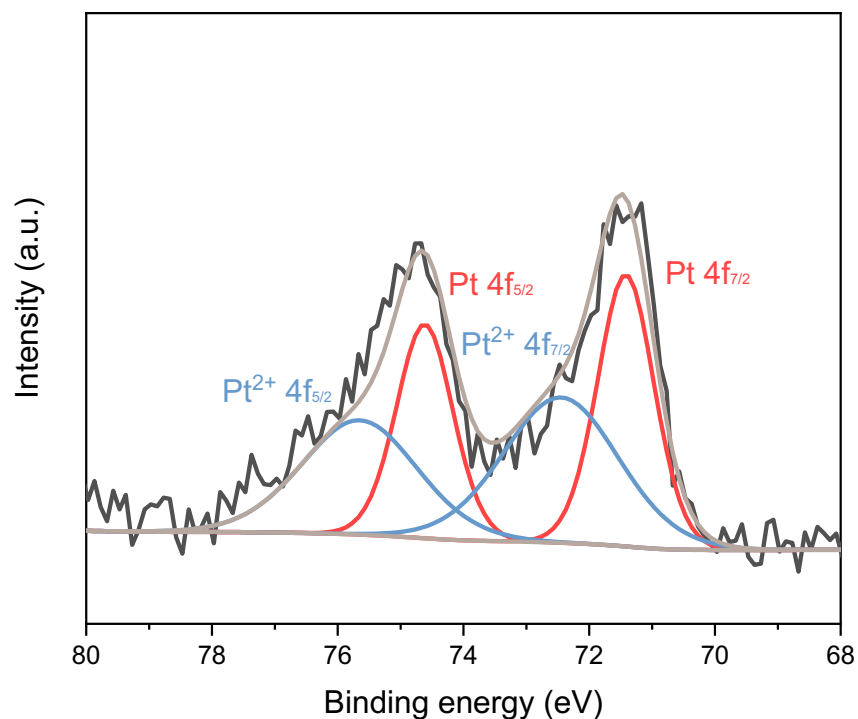


Fig. S12 XPS analysis of the binding energy of Pt in E-MoS₂-Pt taken after 1000 cycles (from -0.1 V to -0.3 V vs. RHE).

Table S1. Electrochemical impedance parameters obtained by fitting the Nyquist plots to the equivalent circuit model in Fig. 4c.

Sample	R_s/Ω	R_{ct}/Ω	CPE-T	CPE-P
E-MoS ₂	9.829	25712	0.00018	0.669
E-MoS ₂ -Pt	7.116	98.44	0.00111	0.79506
E-MoS ₂ -Pt-r	7.105	12.67	0.0229	0.44486
Pt/C	7.009	6.682	0.02489	0.6519

Table S2. Comparisons of the HER performance of E-MoS₂-Pt-r with other related catalysts.

Catalyst	η / mV @ 10 mA cm ⁻²	Tafel / mV dec ⁻¹	Reference
Pt-MoS ₂	~140	96	1
Mo ₂ TiC ₂ T _x -Pt	30	30	2
10%Pd-MoS ₂	72	63	3
Pt-1T ^S -MoS ₂	223	57	4
Pt-1T ^r -MoS ₂	180	88	5
O-MoS ₂ @Pt	144	68	6
Pt-SAs/MoS ₂	59	31	7
Pt/np-Co _{0.85} Se	55	35	8
Pt@PCM	105	64	9
SV-MoS ₂	170	60	10
MoN-NC	62	54	11
MoS ₂ /graphene	137	49	12
Co (10.4)/Se-MoS ₂ -NF	104	67	13
E-MoS ₂ -Pt-r	38	29	this work

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