Electronic Supplementary Information

Interface Modifications for RuO_2-decorated MoS_2 Nanosheets as Excellent Electrocatalyst toward Alkaline Hydrogen Evolution

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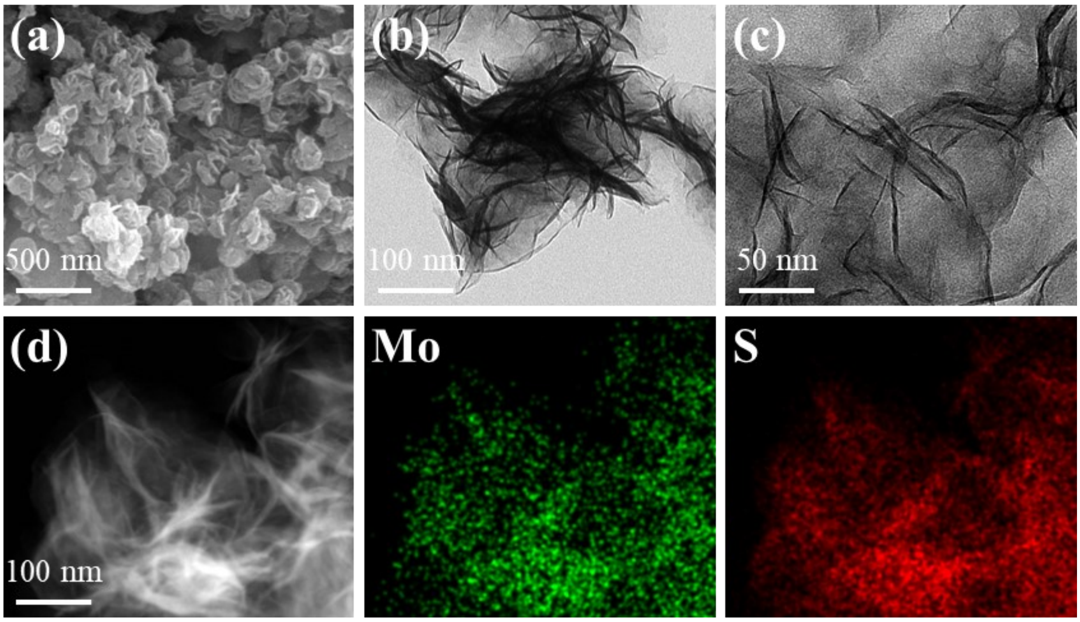

Fig. S1. (a) SEM image of MoS_2. (b-c) TEM images of MoS_2 with different amplifications. (d) TEM-EDS elemental mapping of Mo, S in MoS_2.

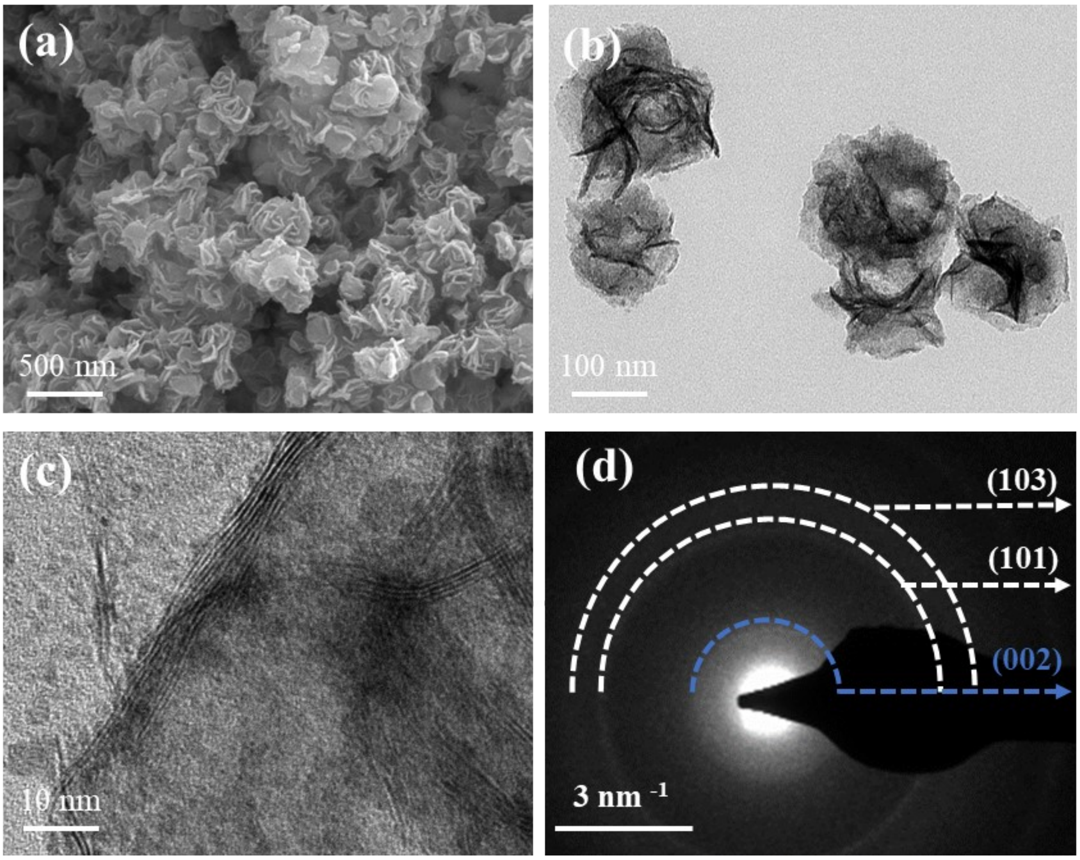

Fig. S2. (a) SEM image of RuO_2/MoS_2 catalyst. (b) TEM image of RuO_2/MoS_2 catalyst. (c) HRTEM image of RuO_2/MoS_2 catalyst. (d) SAED pattern of RuO_2/MoS_2 catalyst.

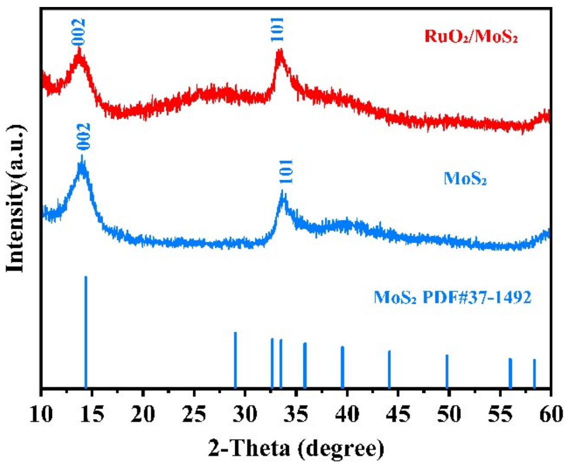

Fig. S3. The XRD patterns of RuO_2/MoS_2 catalyst and MoS_2.

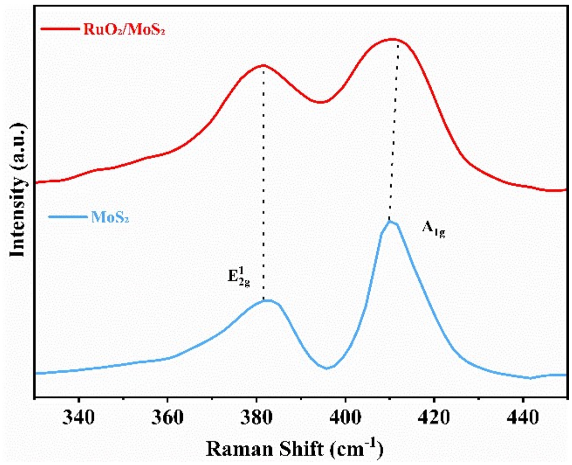

Fig. S4. Raman spectra of RuO_2/MoS_2 catalyst and MoS_2.

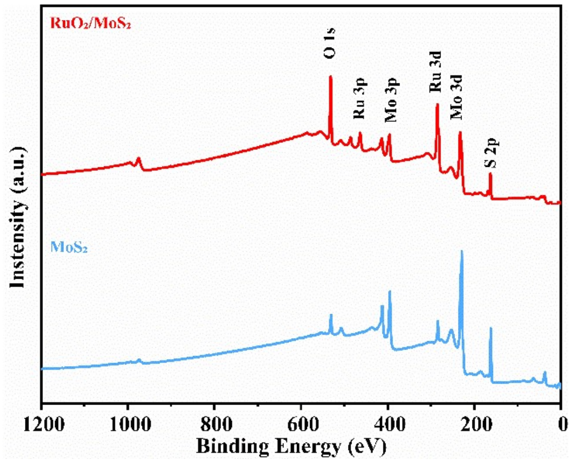

Fig. S5. XPS survey spectra of RuO_2/MoS_2 catalyst and MoS_2.

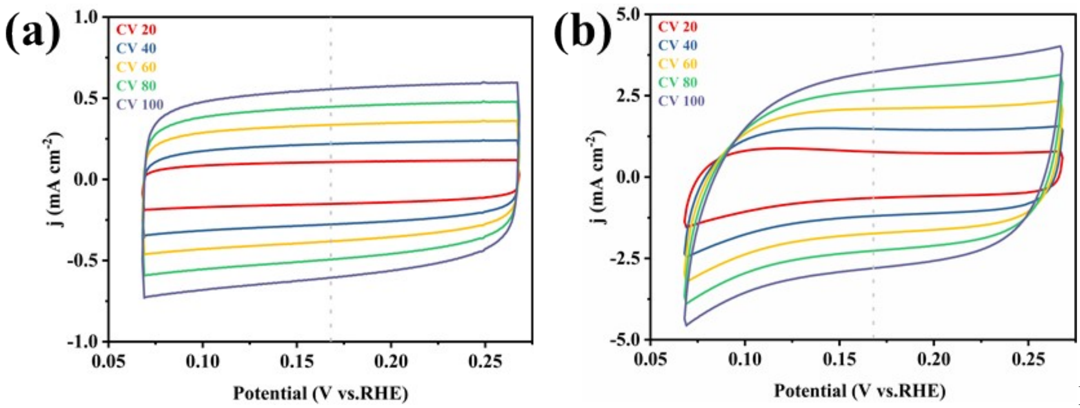

Fig. S6. CV curves of (a) MoS_2, (b) RuO_2/MoS_2 catalyst. at scan rates of 20, 40, 60, 80, 100 mV s^{-1} in 1.0 M KOH, respectively.

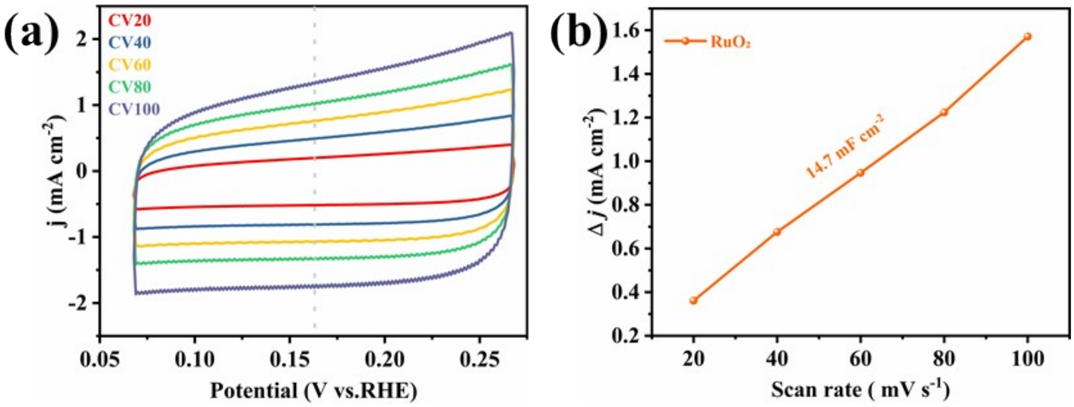

Fig. S7. (a) CV curves of RuO_2 catalyst.at scan rates of 20, 40, 60, 80, 100 mV s^{-1} in 1.0 M KOH, (b) calculated electrochemical double-layer capacitance for RuO_2.

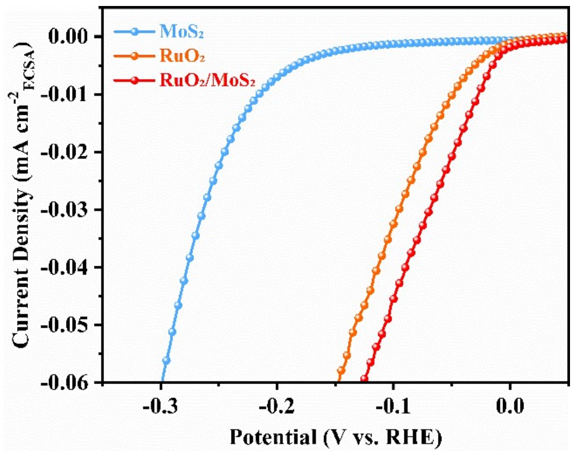

Fig. S8. Polarization curves of MoS_2, RuO_2 and RuO_2/MoS_2 catalyst normalized ECSAs.

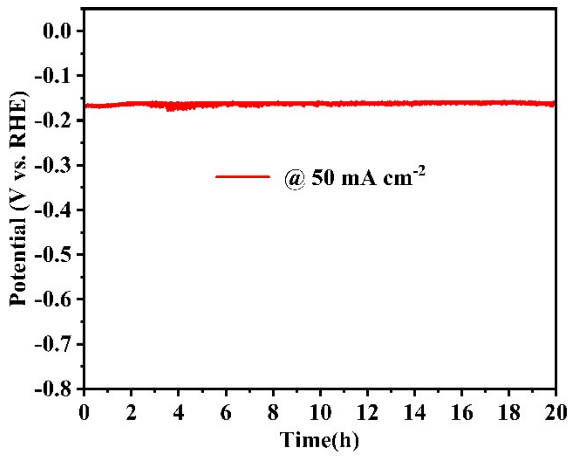

Fig. S9. The long-time chronopotentiometry curve of RuO_2/MoS_2 catalyst at 50 mA cm^{-2}.

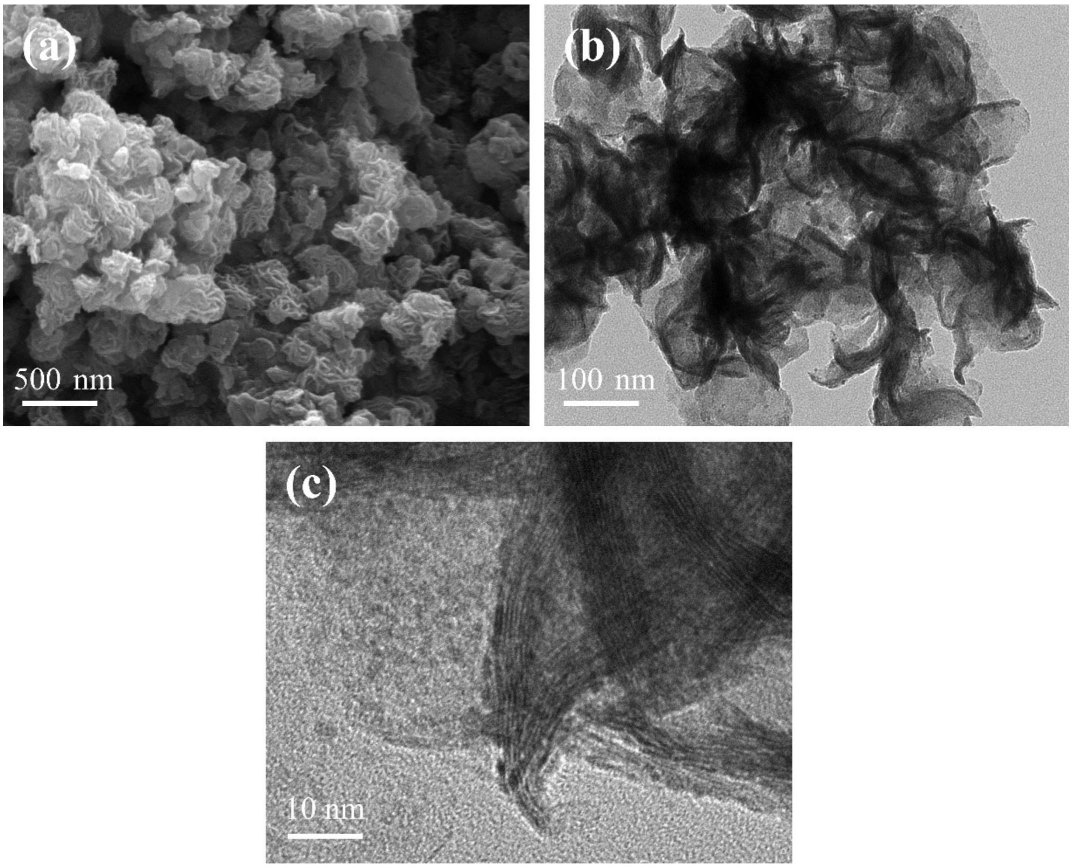

Fig. S10. (a) SEM image of RuO_2/MoS_2 catalyst after long-time HER test. (b-c) TEM and HRTEM images of RuO_2/MoS_2 catalyst.

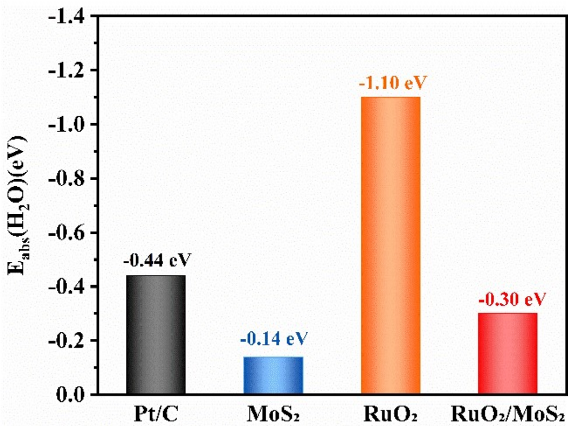

Fig. S11. The adsorption energies of H_2O on Pt/C, MoS_2, RuO_2 and RuO_2/MoS_2 catalyst.

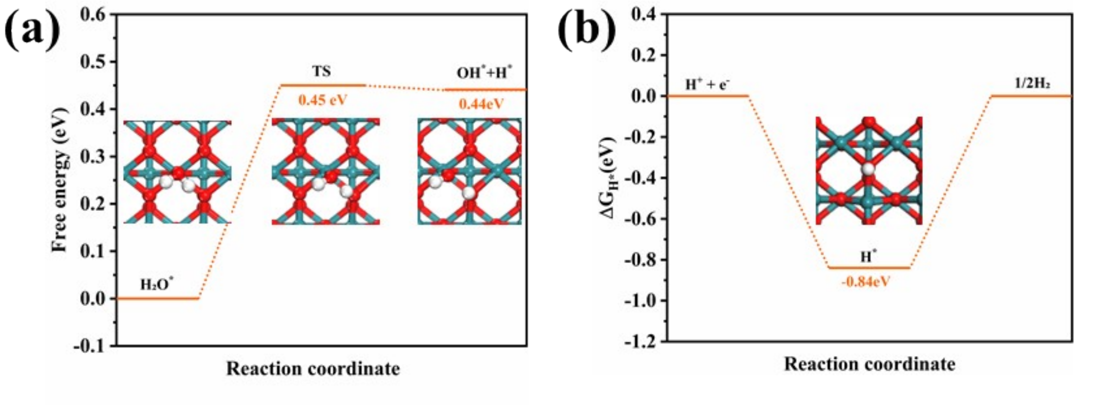

Fig. S12. (a) The free energy diagrams for H_2O dissociation on RuO_2 (110). (b) The hydrogen adsorption free energy of RuO_2 (110).

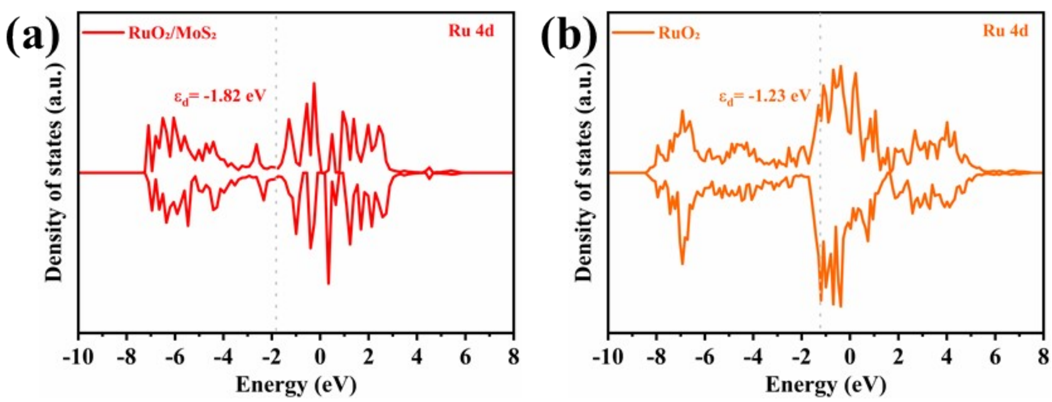

Fig. S13. Projected density states of Ru 4d on (a) RuO_2/MoS_2 catalyst and (b) RuO_2 (110).

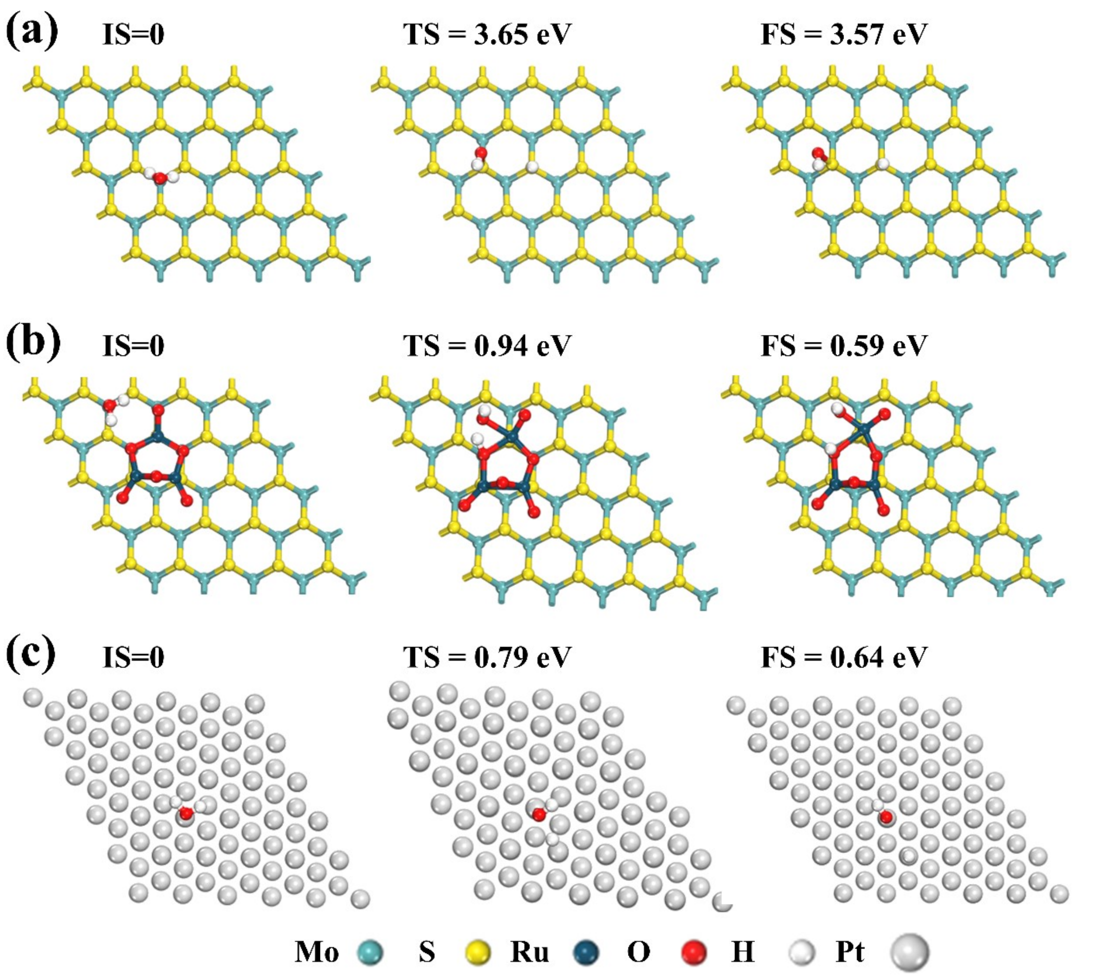

Fig. S14. Optimized adsorption configurations and free energy changes in the water dissociation pathways on (a) MoS_2 (002), (b) RuO_2/MoS_2, and (c) Pt (111).

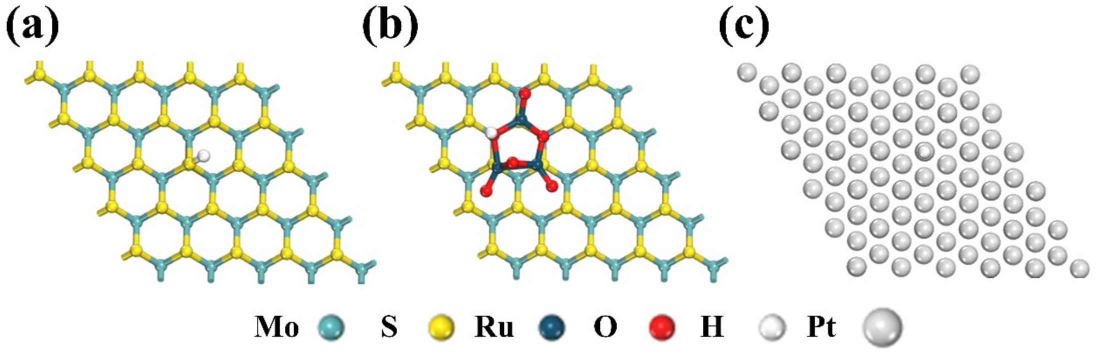

Fig. S15. Optimized H atom adsorb on different DFT models. (a) MoS_2 (002), (b) RuO_2/MoS_2, and (c) Pt (111).

Table S1. Comparison of HER performance of electrocatalysts reported in different literatures in alkaline or acidic solution.

Samples	**η10 （mV）**	**Tafel （mV dec^{-1}）**	**solution**	**Ref.**
1T-2H Cr_x-MoS_2 Ultrathin Nanosheets	200	41.6	alkaline	1
Al-MoS_2	198	134	alkaline	2
1T-2H MoS_2	320	65	alkaline	3
Co@MoS_2-S_V	36	33	alkaline	4
RuO_2/F-graphene	49	31	alkaline	5
RuO_2/N-C	49	44	alkaline	6
Ru-MoS_2	98	65	alkaline	7
Ru-MoS_2/CNT	50	62	alkaline	8
Ni_2P/MoS_2	149	69.5	alkaline	9
MoS_2/Ni_3S_2 heterostructures	110	83	alkaline	10
2D-MoS_2/$Co(OH)_2$	125	76	alkaline	11
Ni-1T-MoS_2	112	48	alkaline	12
NiO@1T-MoS_2	46	52	alkaline	13
NiS microsphere	96	52	acidic	14
2H-TaS_2	145	121	acidic	15
RuSi	42	23.6	acidic	16
Edge-rich 1T-MoS_2/$Ni(OH)_2$	57	30	alkaline	17
RuO_2/MoS_2	**36**	**34.8**	**alkaline**	**This work**

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