Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Electronic Supplementary Information for:

Highly active two dimensional α-MoO_{3-x} for electrocatalytic hydrogen evolution reaction

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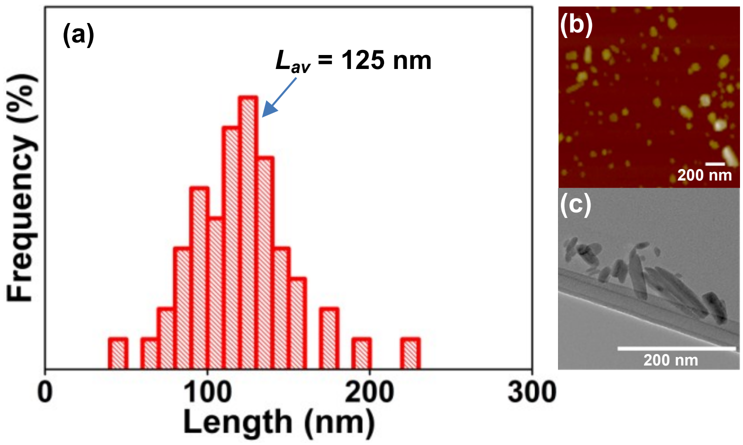

Fig. S1 (a) Frequency histogram of the observed lateral sizes of 2D MoO_{3-x} nanosheets using AFM, (b) large area AFM image of 2D MoO_{3-x} nanosheets, and (c) large area TEM image showing the 2D MoO_{3-x} nanosheets.

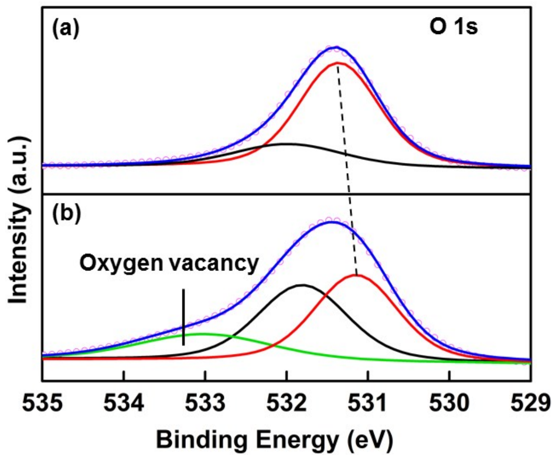

Fig. S2 O 1s XPS spectra of (a) bulk α-MoO_3 and (b) 2D α-MoO_{3-x}.

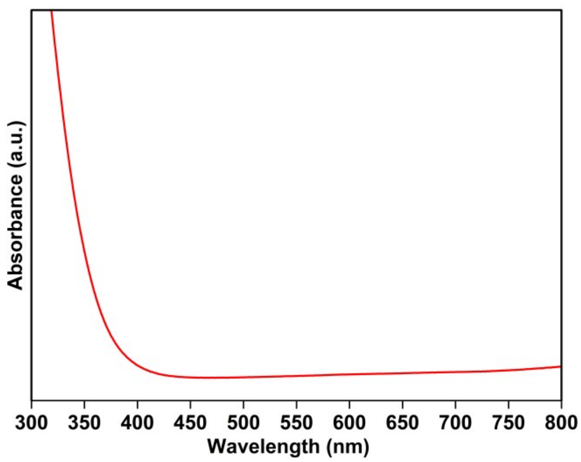

Fig. S3 UV-Vis spectrum of 2D α-MoO_{3-x} suspension.

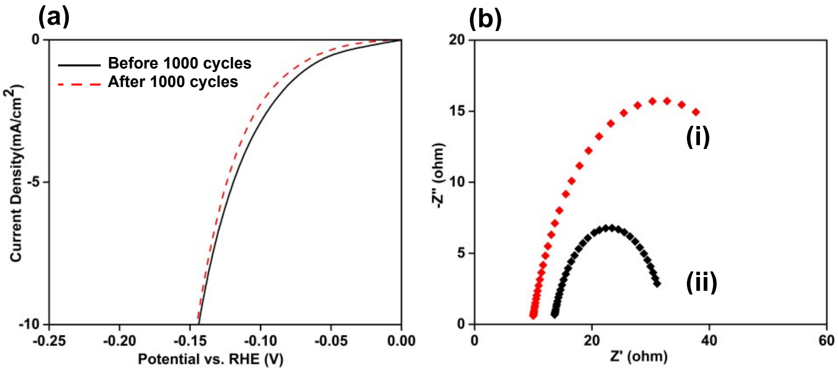

Fig. S4 (a) Linear sweep voltammogram recorded for 2D α-$MoO_{3\text{-}x}$ before and after 1000 cycles of cyclic voltammetry and (b) Fitted Nyquist plot of (i) bulk α-MoO_3 and (ii) 2D α-$MoO_{3\text{-}x}$ at 0.17V *vs.* RHE.

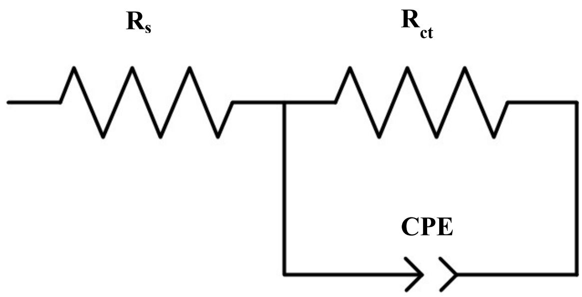

Fig. S5 Equivalent circuit applied to obtain charge transfer resistance of the catalysts in 0.1 M KOH.

Here,

R_s: resistance of the electrolyte

R_{ct}: charge transfer resistance

CPE: constant phase element

Table S1. Impedance components for HER determined by fitting the experimental EIS data using the equivalent circuit shown in **Fig.** S4

Material	**R_s(Ω)**	**R_{ct}(Ω/cm^2)**	**CPE(mF/cm^2)**
2D α-$MoO_{3\text{-}x}$	13.3	19.3	0.78
Bulk α-MoO_3	9.7	43.7	0.79

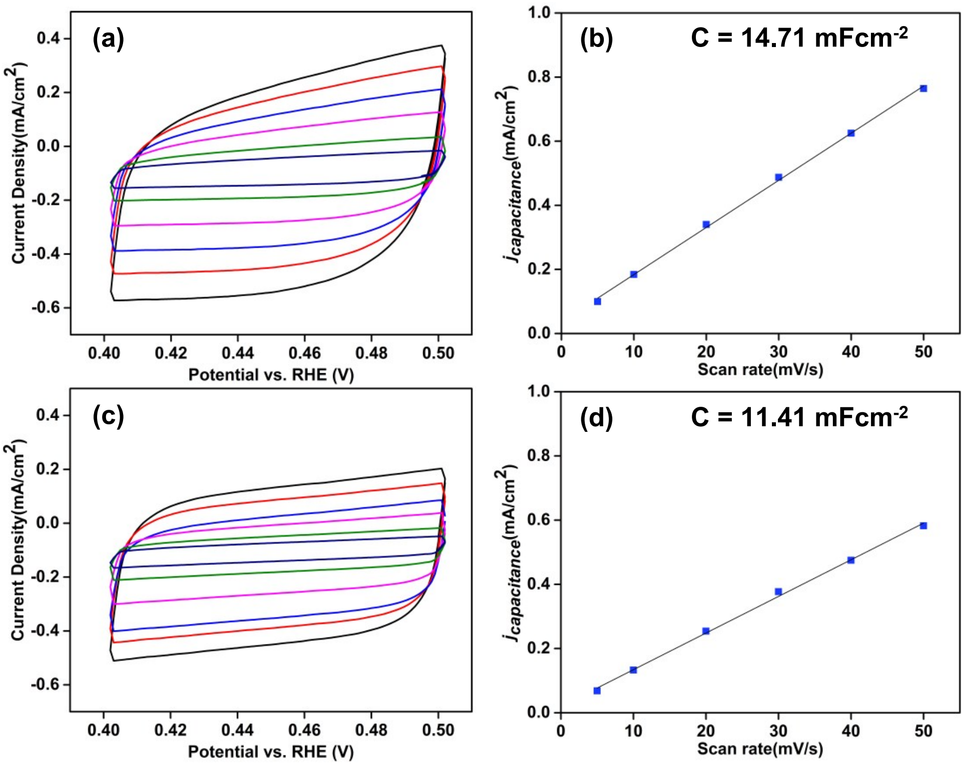

Fig. S6 (a,b) Determination of electrochemical double-layer capacitance of 2D α-MoO_{3-x} nanosheets over a range of scan rates at 0.45 V *vs* RHE in 0.1M KOH and (c,d) determination of electrochemical double-layer capacitance of bulk α-MoO_3 over a range of scan rates at 0.45 V *vs* RHE in 0.1M KOH.

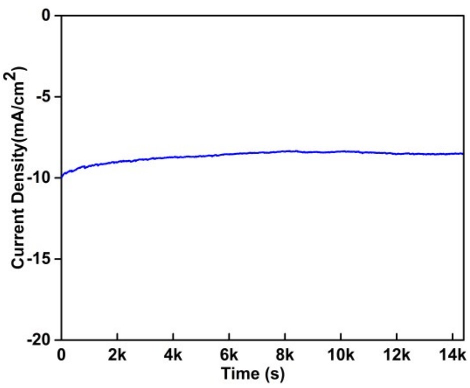

Fig. S7 Time-dependent current density of 2D α-MoO_{3-x} nanosheets during HER with 14.4k seconds at fixed overpotential of 0.14 V *vs* RHE.

Table S2. Comparison of the overpotentials and corresponding Tafel slopes of molybdenum oxides, their compounds and heterostructures as well as selected reports on two dimensional molybdenum sulphides.

Material	Tafel slope (mV dec^{-1})	Overpotential (mV)	Reference
Polycrystalline Pt		21	1
Mesoporous MoO_{3-x}	56	148	2
Core–shell MoO_3–MoS_2 nanowires	60	250	3
MoO_2/rGO composite	68	310	4
P doped MoO_{3-x}	42	166	5
Metallic 1T MoS_2 sheets	43	187	6
Defect-rich MoS_2 sheets	50	~195	7
Amorphous MoS_2	60	~200	8
2D MoO_{3-x}	58	142	This work

References

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