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


# Supporting Information

## Nanoflower-like metallic conductive $MoO_2$ as a high-performance non-precious metal electrocatalyst for hydrogen evolution reaction

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## Additional experimental data

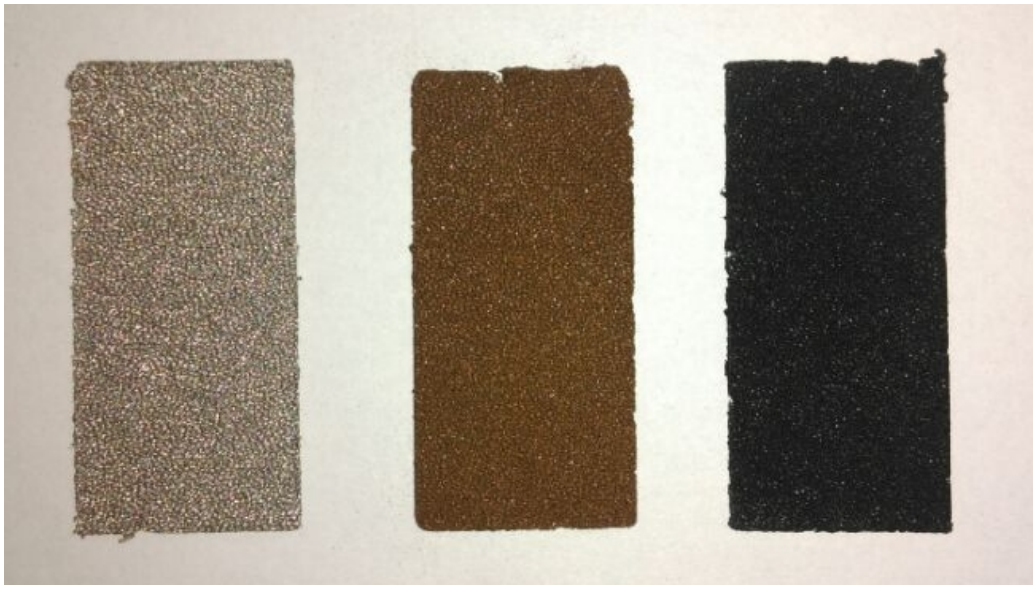

**Figure S1.** Photographs of the nickel foam (left), NFL $MoO_2 \cdot 2H_2O$/NF (middle) and NFL $MoO_2$/NF (right).

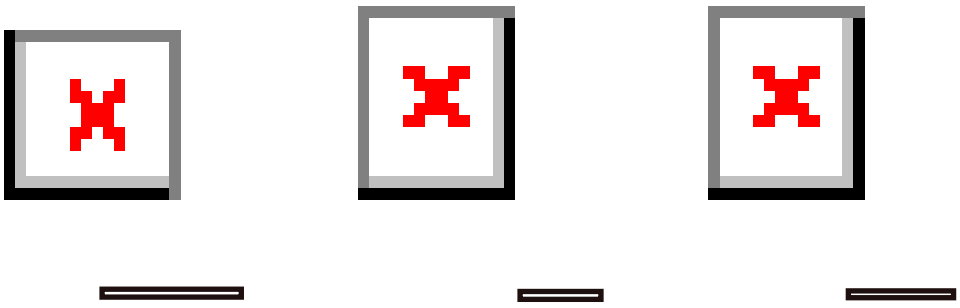

**Figure S2.** SEM images of the nanoflower-like precursor.

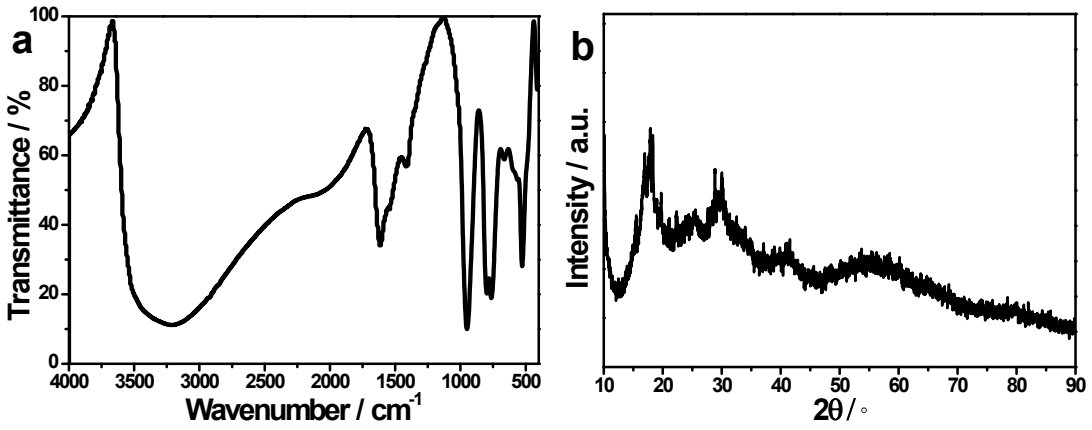


**Figure S3.** IR spectrum and XRD pattern of the precursor.

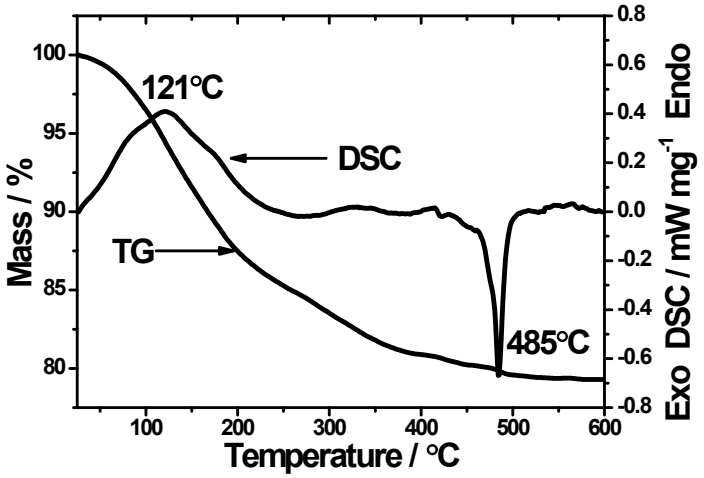


**Figure S4.** TG and DTA curves of the precursor.

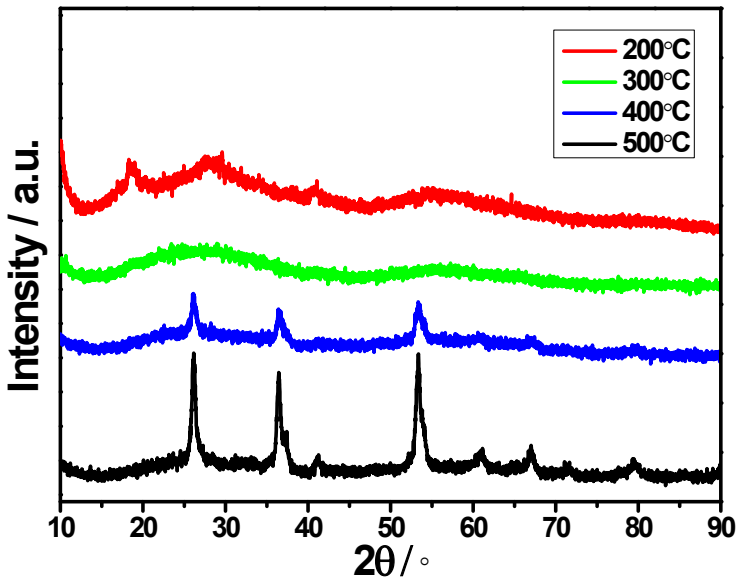


**Figure S5.** XRD patterns of the precursor at different temperatures in $N_2$ atmosphere.

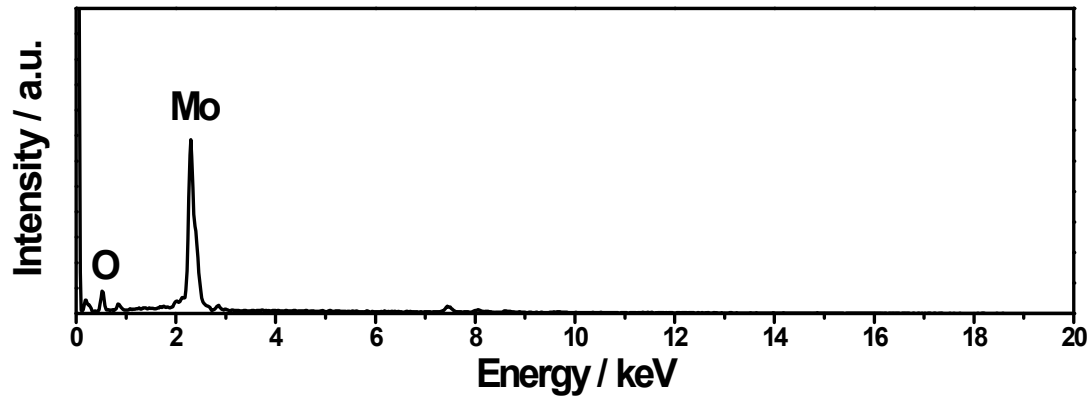


**Figure S6.** EDX spectrum of the nanoflower-like $MoO_2$.

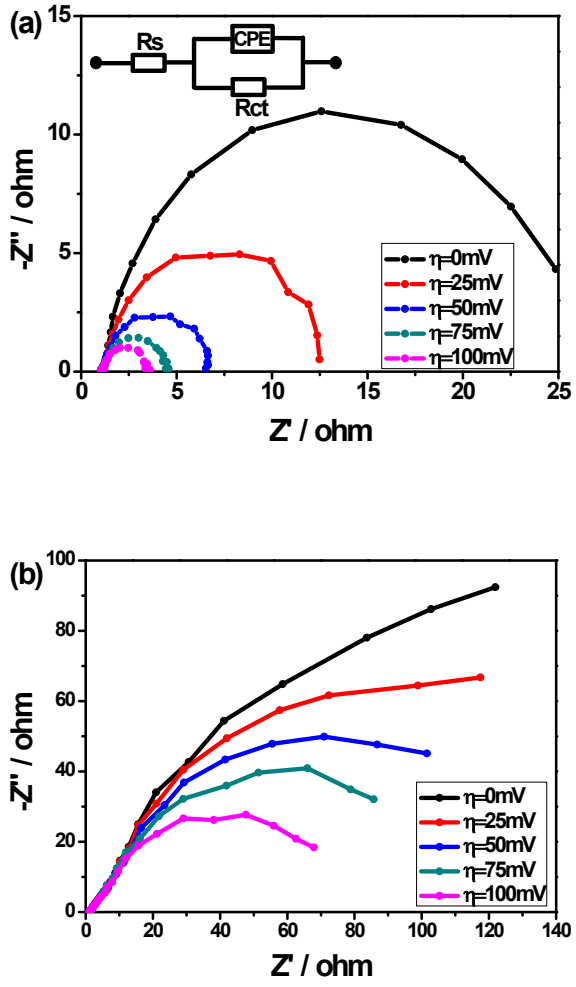


**Figure S7.** (a) The Nyquist plots of NFL $MoO_2$/NF at η=0, 25, 50, 75 and 100 mV (The inset is the electrical equivalent circuit used to model the system of the catalysts), (b) the Nyquist plot of Ni foam at η=0, 25, 50, 75 and 100 mV.

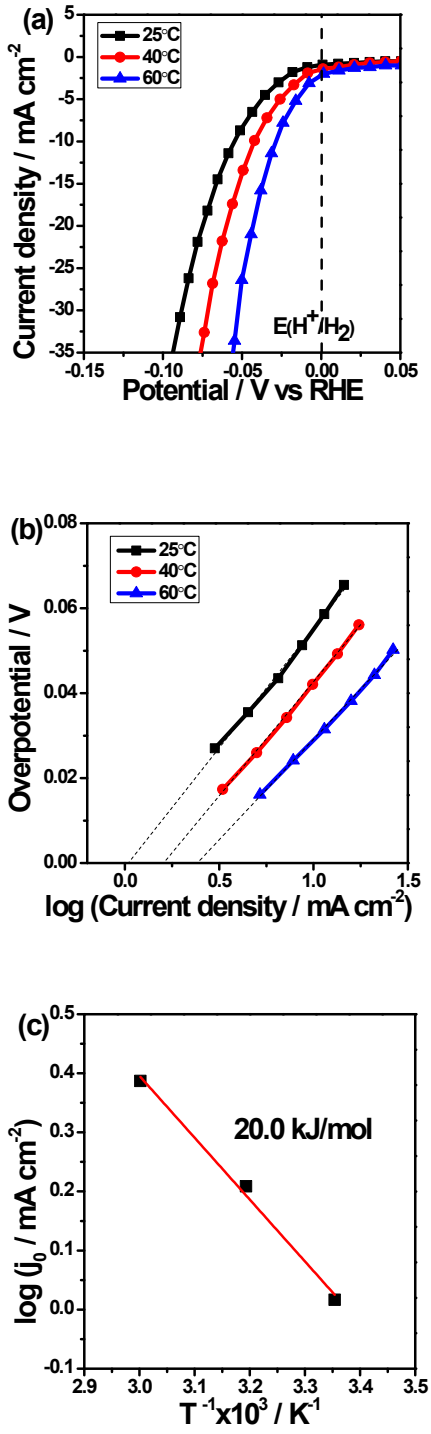


**Figure S8.** Polarization curves (a), Tafel plots (b) for NFL $MoO_2$/NF at different temperatures and c) Arrhenius plots for NFL $MoO_2$/NF.

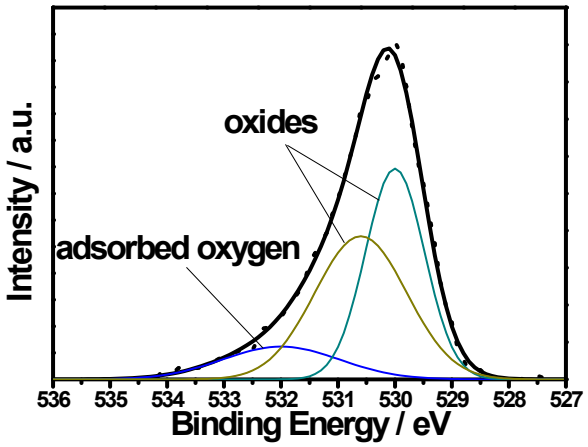


**Figure S9.** XPS spectra of O 1s for NFL $MoO_2$/ NF.

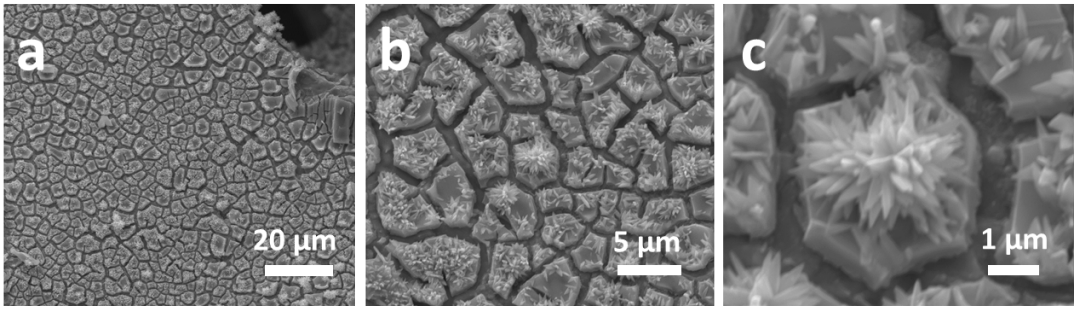


**Figure S10.** a-c) SEM images with different magnifications of the NFL $MoO_2$/NF after HER electrolysis.

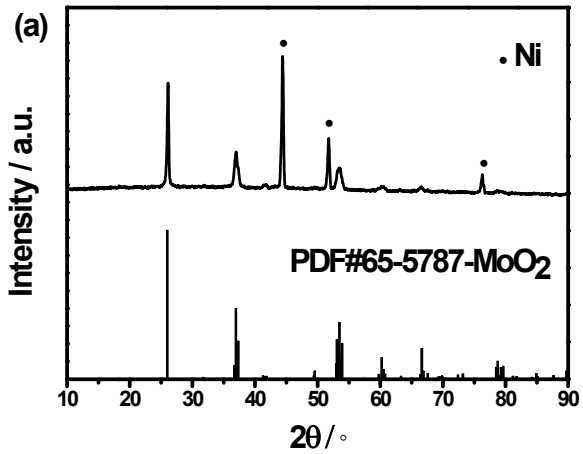


**Figure S11.** a-c) XRD pattern of the NFL $MoO_2$/NF after HER electrolysis.

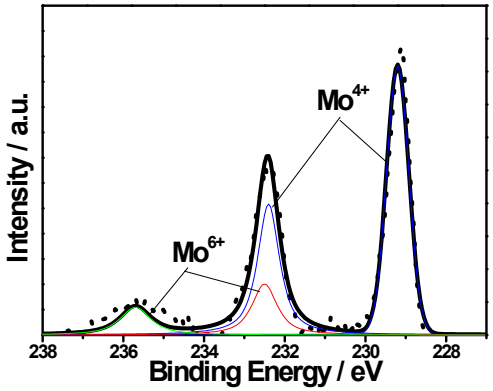


**Figure S12.** XPS spectrum of Mo 3d of the NFL $MoO_2$/NF after HER electrolysis.

**Table S1.** Comparison of HER performance of NFL $MoO_2$/NF with other non-precious-metal HER electrocatalysts.

| Catalyst | Electrolyte | Onset potential (mV) | Overpotential (mV) | Current density ($mA/cm^{-2}$) | Reference |
|---|---|---|---|---|---|
| NiO/Ni-CNT | 1 M KOH | ~0 | 80 | 10 | *Nat. Commun.* **2014**, *5*, 4695 |
| $MoS_2$ | 0.5 M $H_2SO_4$ | 150–200 | ~220 | 10 | *Nature Materials* **2012**,*11*, 963 |
| MoB | 1 M KOH | 140 | 240 | 20 | *Angew. Chem. Int. Ed.* **2012**, *51*, 12703 |
| | 0.5 M $H_2SO_4$ | 140 | 225 | 20 | |
| $Mo_2C$ | 1 M KOH | 100 | 210 | 20 | |
| | 0.5 M $H_2SO_4$ | 130 | 225 | 20 | |
| $WO_2$ | 0.5 M $H_2SO_4$ | 35 | 58 | 10 | *J. Am. Chem. Soc.* **2015**, *22*, 6983 |
| $Cu_3P$ NW/CF | 0.5 M $H_2SO_4$ | 62 | 143 | 10 | *Angew. Chem. Int. Ed.* **2014**, *53*, 5427 |
| CoP/CNT | 0.5 M $H_2SO_4$ | 40 | 122 | 10 | *Angew. Chem. Int. Ed.* **2014**, *126*, 6828 |
| $Ni_2P$ | 0.5 M $H_2SO_4$ | ~40 | 130 | 20 | *J. Am. Chem. Soc.* **2013**, *135*, 9267 |
| | 1 M KOH | ~70 | 205 | 20 | |
| FeP NA/Ti | 0.5 M $H_2SO_4$ | 16 | 240 | 10 | *Angew. Chem. Int. Ed.* **2014**, *53*, 12859 |
| MoP | 0.5 M $H_2SO_4$ | 40 | 125 | 10 | *Adv. Mater.* **2014**, *26*, 5702 |
| NFL $MoO_2$/NF | 1 M KOH | ~0 | 55 | 10 | This work |
| | | | 80 | 20 | |