

## Supporting Information

### **MoS<sub>2</sub> quantum dots decorated RGO: A Designed Electrocatalysts with High Active Site Density for the Hydrogen Evolution Reaction**

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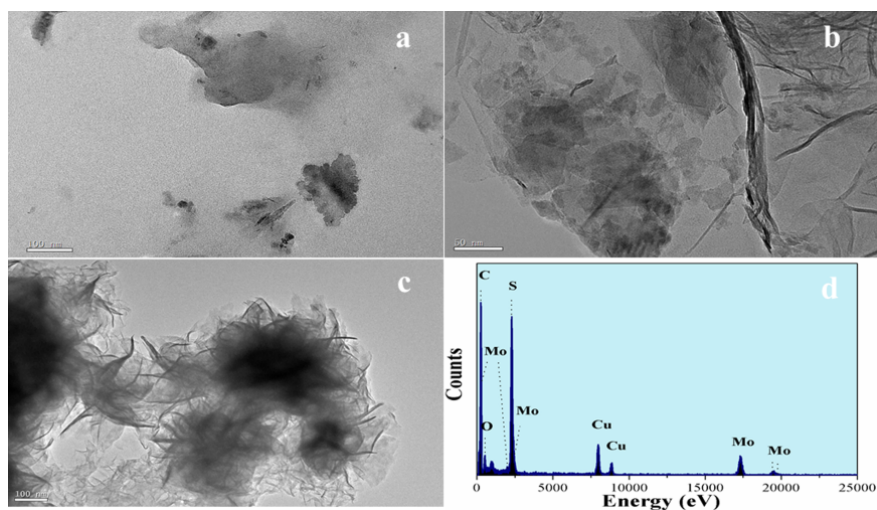
#### **Preparation of graphene oxide**

Graphene oxide (GO) was prepared from natural graphite using a modified Hummers method.<sup>1</sup> Briefly, graphite powder (1 g) was added to a mixture solution of concentrated H<sub>2</sub>SO<sub>4</sub> (120 mL) and H<sub>3</sub>PO<sub>4</sub> (13.4 mL). The resultant mixture was stirred and allowed to cool down to below 5 °C. Then 6 g KMnO<sub>4</sub> was added slowly into the mixture solution, The reaction was then heated to 50 °C and stirred for 12 h, after that the reaction was cooled to room temperature and poured onto ice (400 mL) with 30% H<sub>2</sub>O<sub>2</sub> (3 mL). For workup, the mixture washed in succession three times with 200 mL of water, 200 mL of 30% HCl, then the mixture washed with water until pH>6, the last three times with alcohol and ultrasonic 40 min at last. Finally the mixture was vacuum-dried at room temperature.

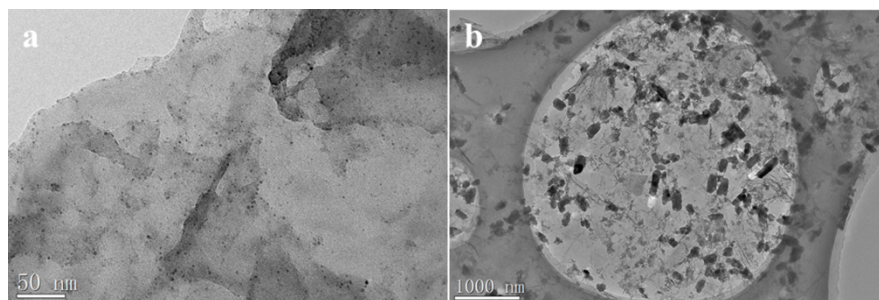
#### **Preparation of reduced graphene oxide**

Briefly, 100 mg GO was dispersed in 100 mL of NaOH solution (pH=13), after that, 1 mL 85% N<sub>2</sub>H<sub>4</sub>·H<sub>2</sub>O was added into the mixed solution, The reaction was then

heated to 100 °C and stirred for 24 h, Product was washed with DI water and methylbenzene several times, and vacuum-dried at room temperature.



**Figure S1.** TEM image of (a) MoS<sub>2</sub> NS, (b) MoS<sub>2</sub> NS/RGO, (C) MoS<sub>2</sub> NFs/RGO and (d) Energy dispersive X-ray (EDX) analysis of MoS<sub>2</sub> QDs/RGO.



**Figure S2.** TEM image of (a) MoS<sub>2</sub> QDs/RGO (10:1) and (b) MoS<sub>2</sub> QDs/RGO (15:1)

**Table S1.** Onset potentials, Tafel slopes, exchange current densities  $j_0$  and TOF value for various catalysts

| Catalyst                 | Onset potential<br>(mV) | Tafel slope b<br>(mV dec <sup>-1</sup> ) | j <sub>0</sub><br>(mA cm <sup>-2</sup> ) | TOF<br>(s <sup>-1</sup> ) |
|--------------------------|-------------------------|--|--|---------------------------|
| MoS <sub>2</sub> NFs/RGO | -0.087                  | 136                                      | 0.066                                    | 0.137                     |
| MoS <sub>2</sub> NS/RGO  | -0.139                  | 112                                      | 0.016                                    | 0.033                     |
| MoS <sub>2</sub> QDs/RGO | -0.008                  | 63                                       | 0.669                                    | 1.39                      |
| MoS <sub>2</sub> QDs     | -0.102                  | 101                                      | 0.023                                    | 0.046                     |
| Pt/C                     | -0.003                  | 40                                       | 0.999                                    | 2.07                      |

**Table S2.** Summary of representative HER catalysts of MoS<sub>2</sub> (as mentioned in the main text)

| Catalyst                      | Loading<br>amounts<br>(mg cm <sup>-2</sup> ) | Current<br>density<br>(mA cm <sup>-2</sup> ) | Overpot-<br>ential<br>(mV) | Electrolyte<br>solution<br>(H <sub>2</sub> SO <sub>4</sub> ) | Reference |
|-------------------------------|--|--|----------------------------|--|-----------|
| MoS <sub>2</sub> /RGO         | 0.285  | 10   | ~150                       | 0.5 M  | 39        |
| MoS <sub>2</sub> /TCNQ/Ccloth | 3.41   | 10   | >100                       | 0.5 M  | 18        |
| MoS <sub>2</sub> ⊥RGO         | 0.204  | 10   | 172                        | 0.5 M  | 20        |
| 1T- MoS <sub>2</sub>          | 0.216  | 10   | 550                        | 0.5 M  | 21        |
| MoS <sub>2</sub> -NCNFs       | 0.855  | 10   | 120                        | 0.5 M  | 22        |
| MoS <sub>2</sub> /CC          | 0.19   | 10   | >100                       | 0.5 M  | 19        |
| MoS <sub>2</sub> QDs          | 0.036  | 10   | >200                       | 0.5 M  | 24        |
| Cu-MoS <sub>2</sub> /RGO      | 0.285  | 10   | 244                        | 0.5 M  | 30        |
| MoS <sub>2</sub> QDs/RGO      | 0.285  | 10   | 64                         | 0.5 M  | This work |

## References

1. D. C. Marcano, D. V. Kosynkin, J. M. Berlin, A. Sinitskii, Z. Sun, A. Slesarev, L. B.

Alemaný, W. Lu and J. M. Tour, *ACS Nano*, 2010, **4**, 4806-4814.