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

In-situ synthesis of hierarchical $MoSe_2$-$CoSe_2$ nanotubes as efficient electrocatalyst for hydrogen evolution reaction in both acidic and alkaline medium

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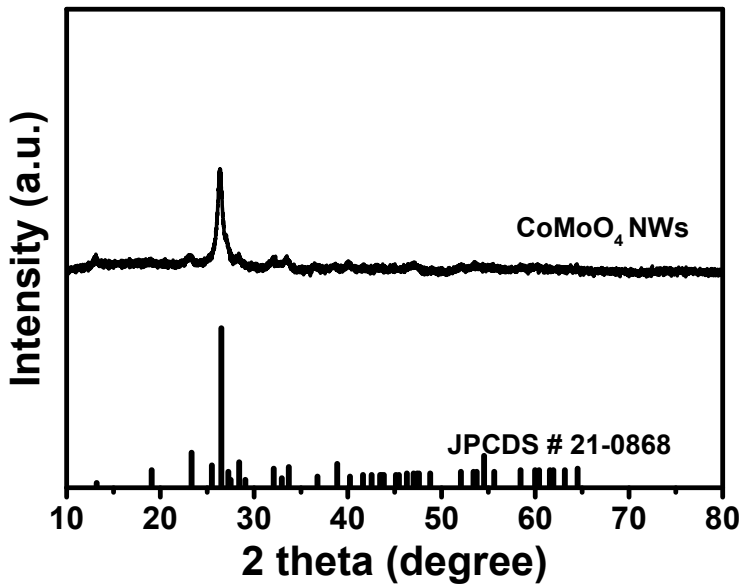

Fig. S1 XRD pattern of $CoMoO_4$ NWs

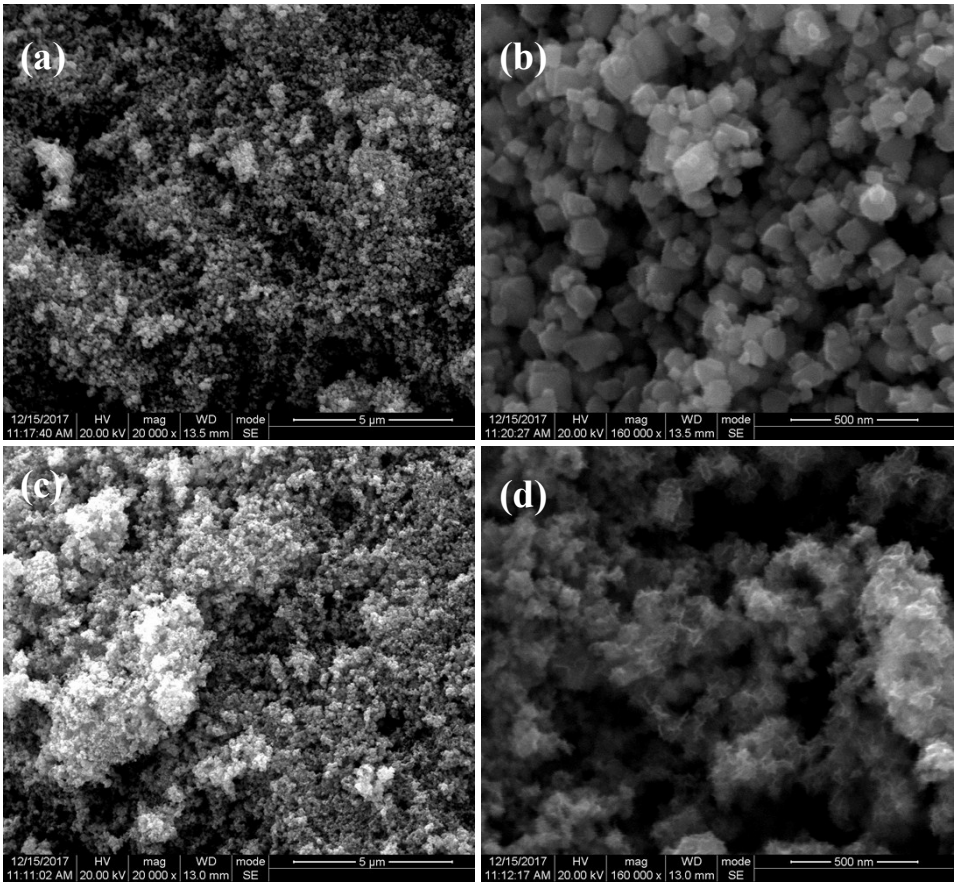

Fig. S2 (a-b) SEM images of $CoSe_2$ particles. (c-d) SEM images of $MoSe_2$ nanoflowers.

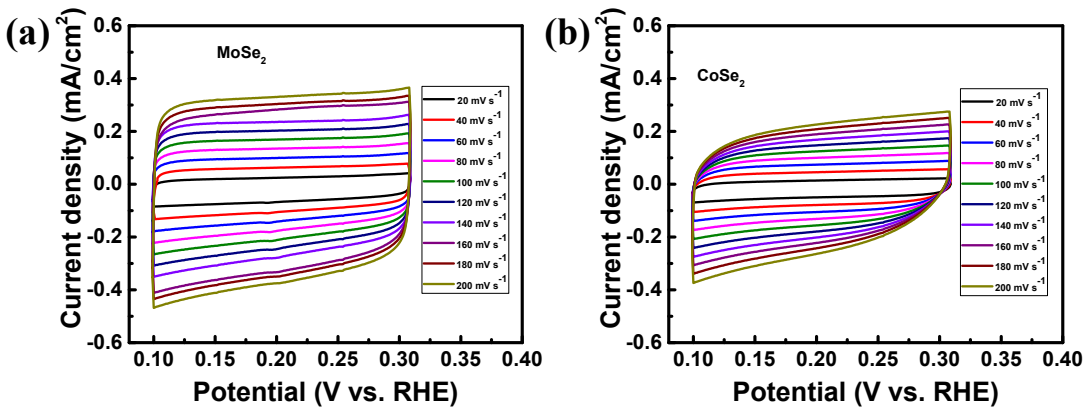

Fig. S3 Voltammograms of $MoSe_2$ and $CoSe_2$ recorded at the scan rates of 20–200 mV s^{-1} in the region of 0.1–0.3 V vs. RHE.

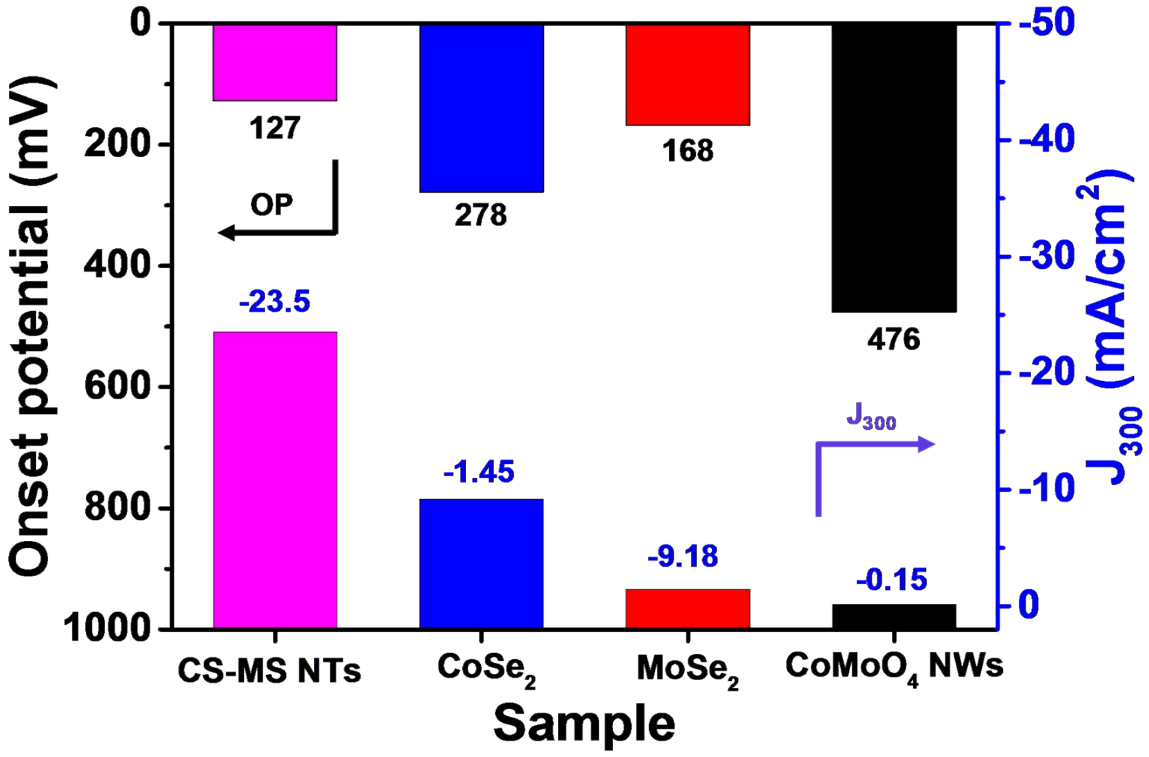

Fig. S4 Onset potential (op) and J_{300} values of $CoMoO_4$ NWs, $MoSe_2$, $CoSe_2$ and MS-CS NTs in 1 M KOH.

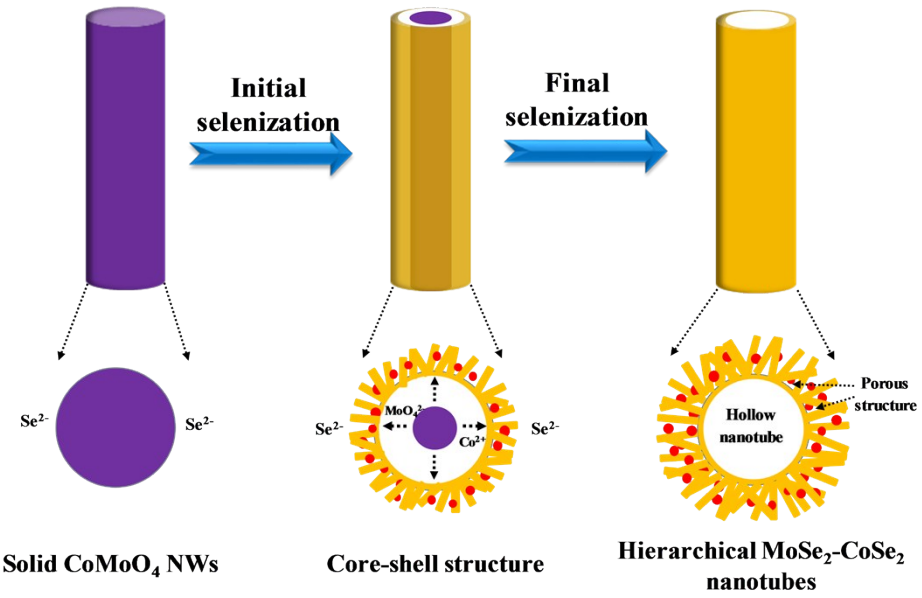

Fig. S5 Schematic illustration for the formation process and conversion mechanism of hierarchical MS-CS NTs.

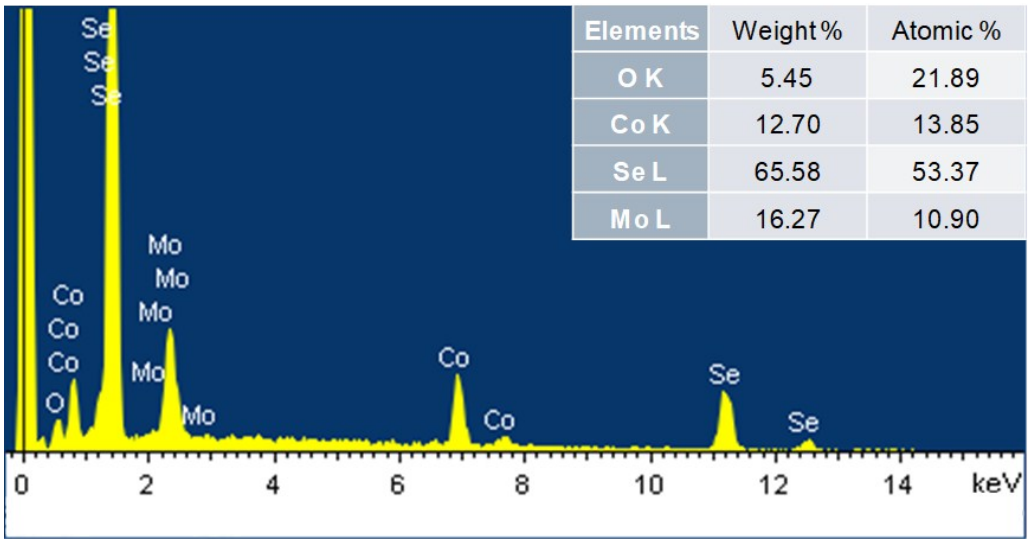

Fig. S6 EDS spectrum of the hierarchical MS-CS NTs.

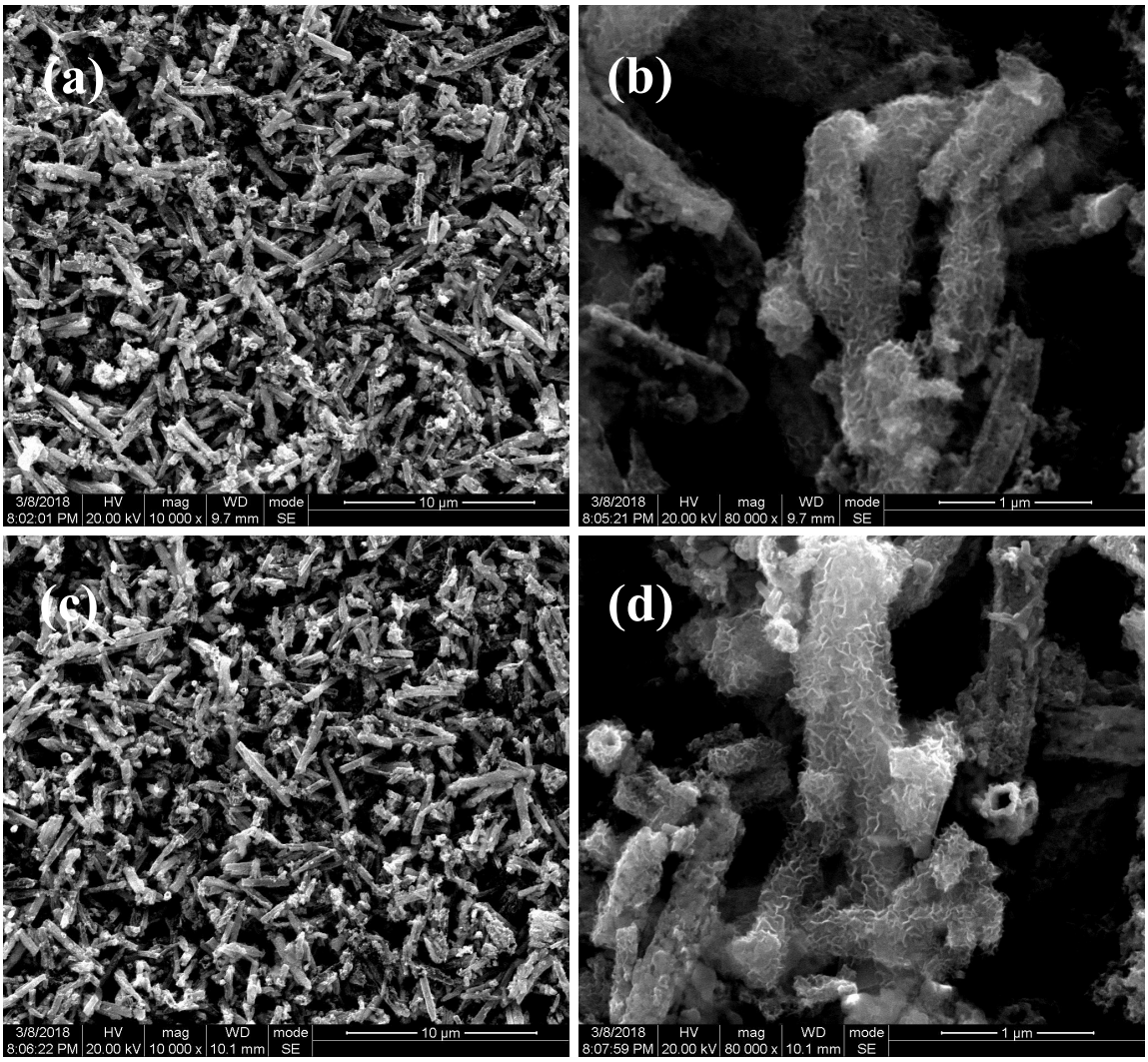

Fig. S7 (a-b) SEM images of MS-CS NTs after 1500 CV cycles in 0.5 M H_2SO_4. (c-d) SEM images of MS-CS NTs after 1500 CV cycles in 1 M KOH.

Table. S1 Summary of electrochemical performance of some advanced catalysts in previous works and our work.

Samples	Loading (mg/cm^2)	Onset overpotential (mV vs RHE)		J_{300} (mA/cm^2) @ 300 mV vs RHE		Tafel slope ($mVdec^{-1}$)		References
		H_2SO_4	KOH	H_2SO_4	KOH	H_2SO_4	KOH	
MS-CS NTs	0.57	148	127	-84.6	-23.5	45	89	**This work**
$CoSe_2$ NPs	0.57	192	278	-40.1	-1.45	56	120	**This work**
$MoSe_2$ NFs	0.57	169	168	-18.8	-9.8	83	104	**This work**
$Mo_{1-x}W_xSe_2$	1	~150	~150	—	—	73	101	1
$CoSe_2$–$SnSe_2$	0.57	>200	—	<10	—	74.5	—	2
CoS/MoS_2	—	—	~130	—	~45	—	106	3
o-$CoSe_2$	0.28	—	~120	—	~15	—	120	4
c-$CoSe_2$	0.28	—	~100	—	~25	—	85	4
RGO/WSe_2	0.57	~150	—	38.4	—	57.6	—	5
$MoSe_2$/CB	0.48	~150	—	~44	—	62	—	6
3D $MoSe_2$	—	~200	—	~7	—	49.6	—	7
$MoSe_2/Cu_3Se_2$	—	100	—	—	—	46	—	8
$MoSe_2$/CoMoSe	—	~150	—	~12	—	95.2	—	9
ZnSe/$MoSe_2$	0.256	68	—	~52	—	73	—	10

References

1 O. E. Meiron, V. Kuraganti, I. Hod, R. Bar-Ziv and M. Bar-Sadan, Nanoscale, 2017, 9, 13998.

2 B. Yu, F. Qi, B. Zheng, W. Hou, W. Zhang, Y. Li and Y. Chen, J. Mater. Chem. A, 2018, 6, 1655.

3 H. Lin, H. Li, Y. Li, J. Liu, X. Wang and L. Wang, J. Mater. Chem. A, 2017, 5, 25410.

4 P. Chen, K. Xu, S. Tao, T. Zhou, Y. Tong, H. Ding, L. Zhang, W. Chu, C. Wu and Y. Xie, Adv. Mater., 2016, 28, 7527.

5 X. Wang, Y. Chen, B. Zheng, F. Qi, J. He, P. Li and W. Zhang, Electrochim. Acta, 2016, 222, 1293.

6 N. Xue and P. Diao, The Journal of Physical Chemistry C, 2017, 121, 26686.

7 B. Zheng, Y. Chen, F. Qi, X. Wang, W. Zhang, Y. Li and X. Li, 2D MATERIALS, 2017, 4, 025092.

8 S. Poorahong, R. Izquierdo and M. Siaj, J. Mater. Chem. A, 2017, 5, 20993.

9 X. Chen, Y. Qiu, G. Liu, W. Zheng, W. Feng, F. Gao, W. Cao, Y. Fu, W. Hu and P. Hu, J. Mater. Chem. A, 2017, 5, 11357.

10 M. Wu, Y. Huang, X. Cheng, X. Geng, Q. Tang, Y. You, Y. Yu, R. Zhou and J. Xu, Advanced Materials Interfaces, 2017, 4, 1700948.