

## **Supporting information**

### **Design of Mo-doped cobalt sulfide hollow nanocages from zeolitic imidazolate framework as advanced electrodes for supercapacitors**

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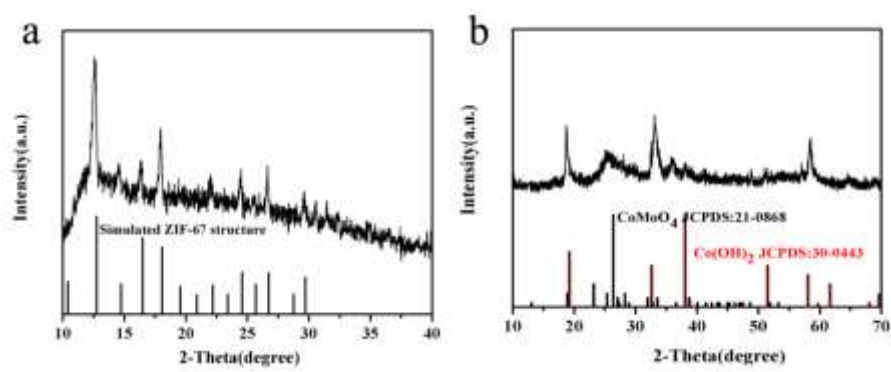


Fig. S1 XRD patterns of (a) ZIF-67 and (b) CoMoO<sub>4</sub>-Co(OH)<sub>2</sub> HNC.

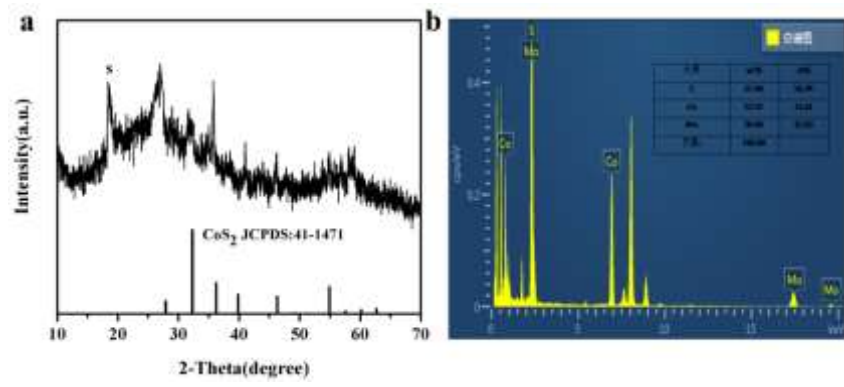


Fig. S2 (a) XRD pattern and (b) EDS spectrum of Mo-doped CoS HNC.

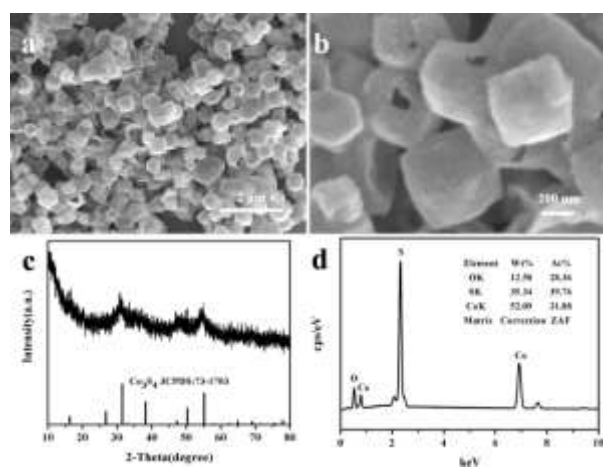


Fig. S3 (a, b) SEM images, (c) XRD pattern and (d) EDS spectrum of CoS HNC.

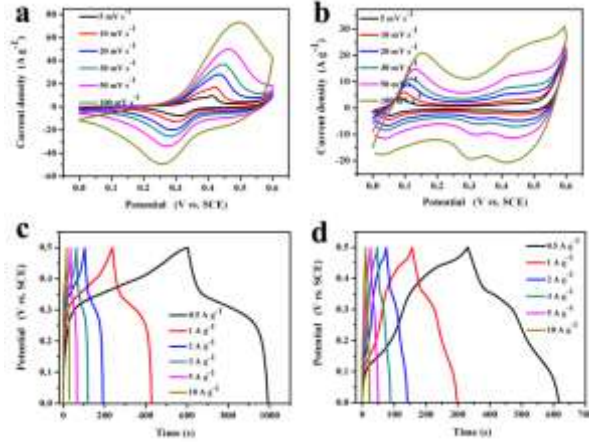
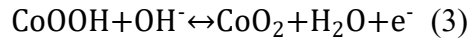
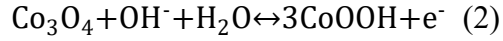
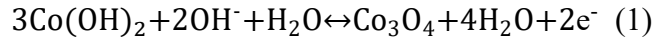


Fig. S4 (a) CV curves of CoS HNC in the scan rate of 5-100  $\text{mV s}^{-1}$ . (b) CV curves of  $\text{CoMoO}_4\text{-Co(OH)}_2$  HNC in the scan rate of 5-100  $\text{mV s}^{-1}$ . (c) GCD curves of CoS HNC at different current densities. (d) GCD curves of  $\text{CoMoO}_4\text{-Co(OH)}_2$  HNC at different current densities.

The CV curves of  $\text{CoMoO}_4\text{-Co(OH)}_2$  HNC has two pairs of redox peaks owing to  $\text{Co}^{2+}/\text{Co}^{3+}$  and  $\text{Co}^{3+}/\text{Co}^{4+}$  transformations. The corresponding redox reactions can be describes as follows:



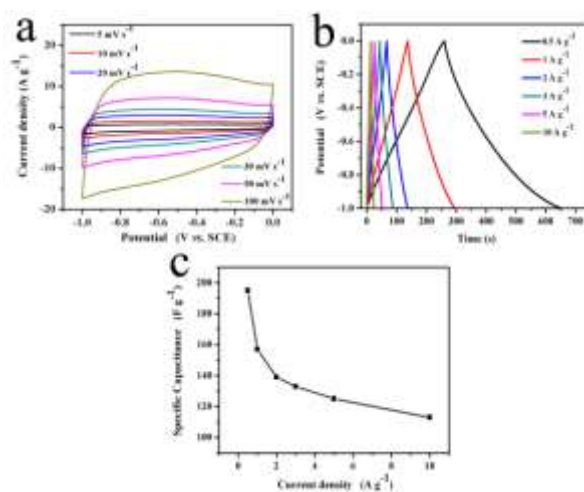


Fig. S5 (a) CV curve of AC electrode at different current densities. (b) GCD curves of AC electrode at different current densities. (c) The specific capacitance of the AC electrode at various current densities.

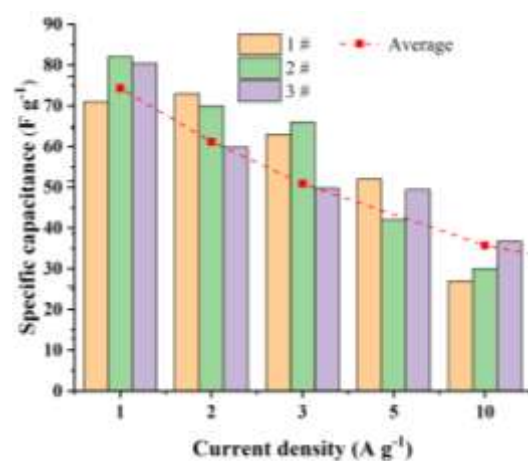


Fig. S6 Specific capacitances of three ASCs fabricated under the same conditions and the average values.

Table S1. Comparison of the electrochemical performance of this work with metal sulfides and their hybrid electrodes reported in literature.

| <b>Electrodes materials</b>  | <b>Specific capacitance</b> | <b>Current density</b>  | <b>Refs</b> |
|------------------------------|-----------------------------|-------------------------|-------------|
| Amorphous CoMoS <sub>4</sub> | 661 F g <sup>-1</sup>       | 1 A g <sup>-1</sup>     | 1           |
| CoMoS <sub>4</sub>           | 415 F g <sup>-1</sup>       | 0.5 A g <sup>-1</sup>   | 2           |
| flower-like CoS              | 357 F g <sup>-1</sup>       | 0.5 A g <sup>-1</sup>   | 3           |
| Mn-doped CoS                 | 621 F g <sup>-1</sup>       | 0.5 mA cm <sup>-2</sup> | 4           |
| Ag/CoS                       | 370 F g <sup>-1</sup>       | 1 A g <sup>-1</sup>     | 5           |
| CoS <sub>x</sub> /C          | 496.8 F g <sup>-1</sup>     | 0.5 A g <sup>-1</sup>   | 6           |
| Mo-doped CoS HNC             | 781.0 F g <sup>-1</sup>     | 0.5 A g <sup>-1</sup>   | This Work   |
| Mo-doped CoS HNC             | 758.2 F g <sup>-1</sup>     | 1 A g <sup>-1</sup>     | This Work   |



## References

1. X. Xu, Y. Song, R. Xue, J. Zhou, J. Gao and F. Xing, *Chemical Engineering Journal*, 2016, **301**, 266-275.
2. Y.-H. Dai, L.-B. Kong, K. Yan, M. Shi, T. Zhang, Y.-C. Luo and L. Kang, *RSC Advances*, 2016, **6**, 7633-7642.
3. J. Zhu, L. Xiang, D. Xi, Y. Zhou and J. Yang, *Bulletin of Materials Science*, 2018, **41**.
4. S. K. Shinde, M. B. Jalak, S. Y. Kim, H. M. Yadav, G. S. Ghodake, A. A. Kadam and D. Y. Kim, *Ceramics International*, 2018, **44**, 23102-23108.
5. Q. Xu, D. Jiang, T. Wang, S. Meng and M. Chen, *RSC Advances*, 2016, **6**, 55039-55045.
6. L. Ying, J. Zhou, W. Fu, Z. Peng, X. Pan and E. Xie, *Carbon*, 2017, **114**, 187-197.