

## Supporting information

### In-situ Formed Oxy/Hydroxide Antenna Accelerating Water Dissociation Kinetics on Co@N-Doped Carbon Core-Shell Assemble for Hydrogen Production in Alkaline Solution

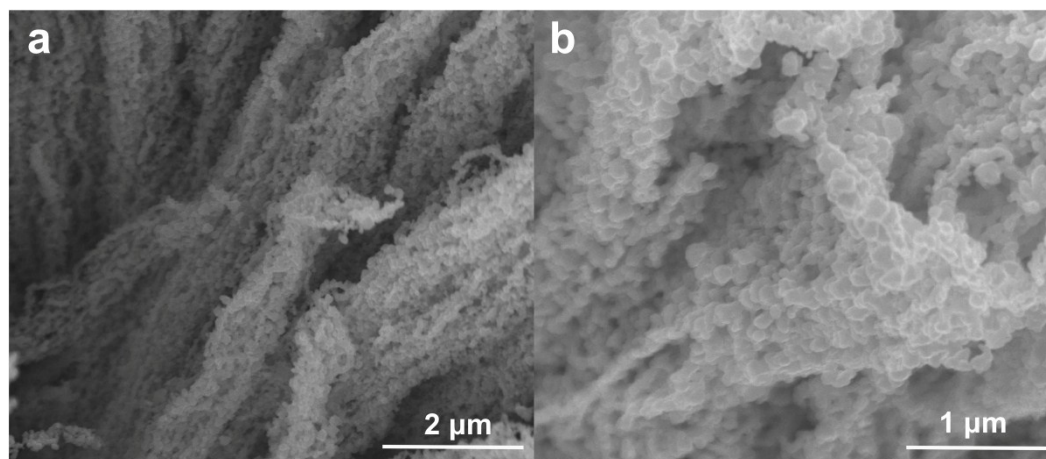
Tao Yang,<sup>†</sup> Lang Pei,<sup>§</sup> Shicheng Yan,<sup>†,\*</sup> Zhentao Yu,<sup>†</sup> Tao Yu,<sup>‡</sup> and Zhigang Zou<sup>†,‡</sup>

<sup>†</sup>Jiangsu Key Laboratory of Artificial Functional Materials, National Laboratory of Solid State Microstructures, Collaborative Innovation Center of Advanced Microstructures, Eco-Materials and Renewable Energy Research Center (ERERC), College of Engineering and Applied Sciences, Nanjing University, Nanjing, Jiangsu 210093, P. R. China

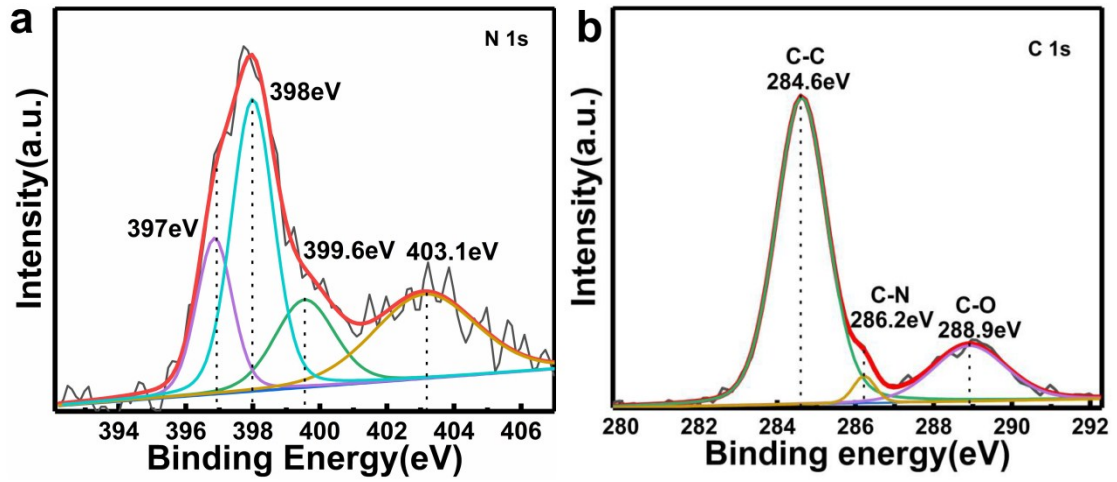
<sup>§</sup>College of Materials and Environmental Engineering Hangzhou Dianzi University Hangzhou 310018, P.R.China

<sup>‡</sup>Jiangsu Province Key Laboratory for Nanotechnology, School of Physics, Nanjing University, Nanjing, Jiangsu 210093, P. R. China

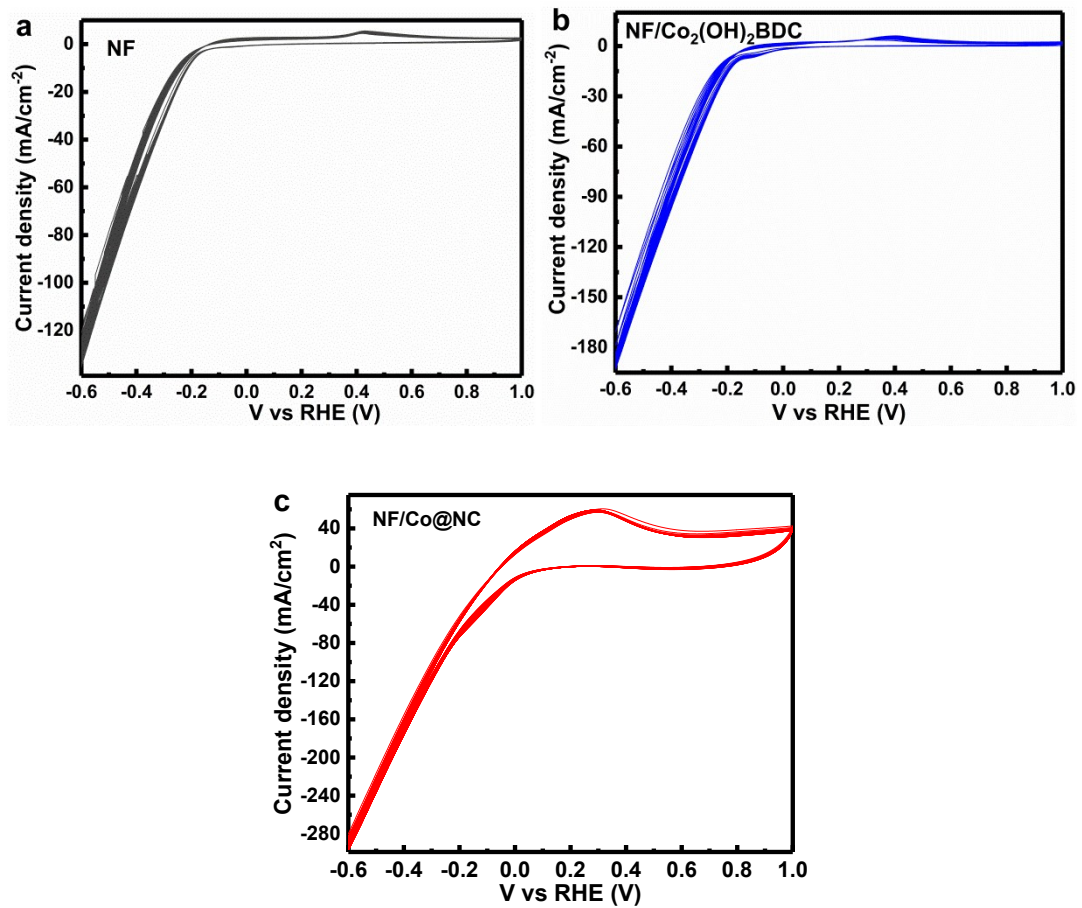
\*Corresponding author E-mail: [yscfei@nju.edu.cn](mailto:yscfei@nju.edu.cn)



**Figure S1.** SEM images of Co@NC grown on nickel foam, it has a shape similar to sorghum spike.



**Figure S2.** The N1s and C1s XPS spectra of NF/Co/NC before HER test.



**Figure S3.** 50-cycling CV (1 h) curves of all the electrodes before HER test to achieve a stable state

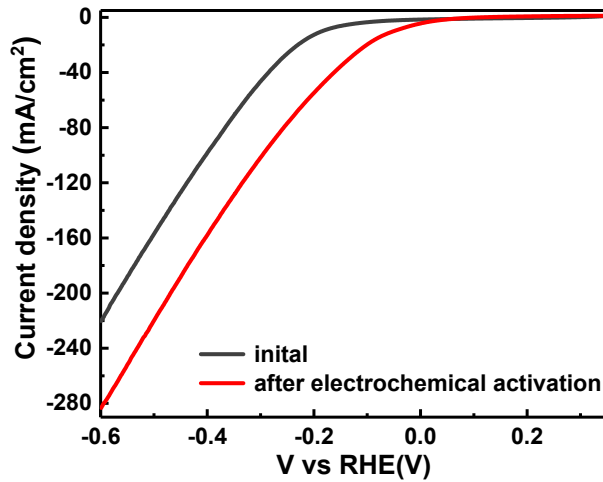


Figure S4. HER performance of NF/Co@NC before and after electrochemical activation.

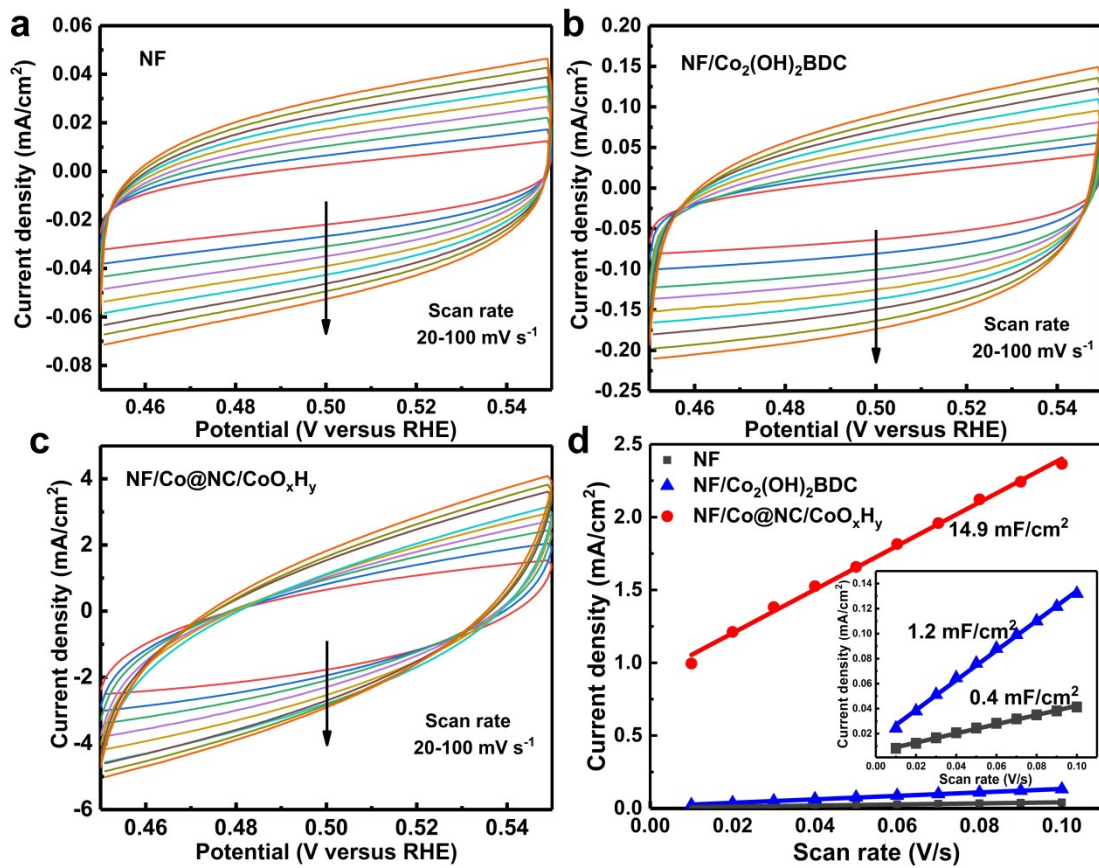
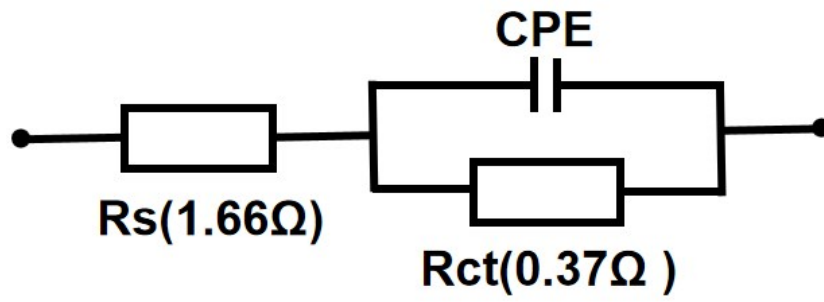
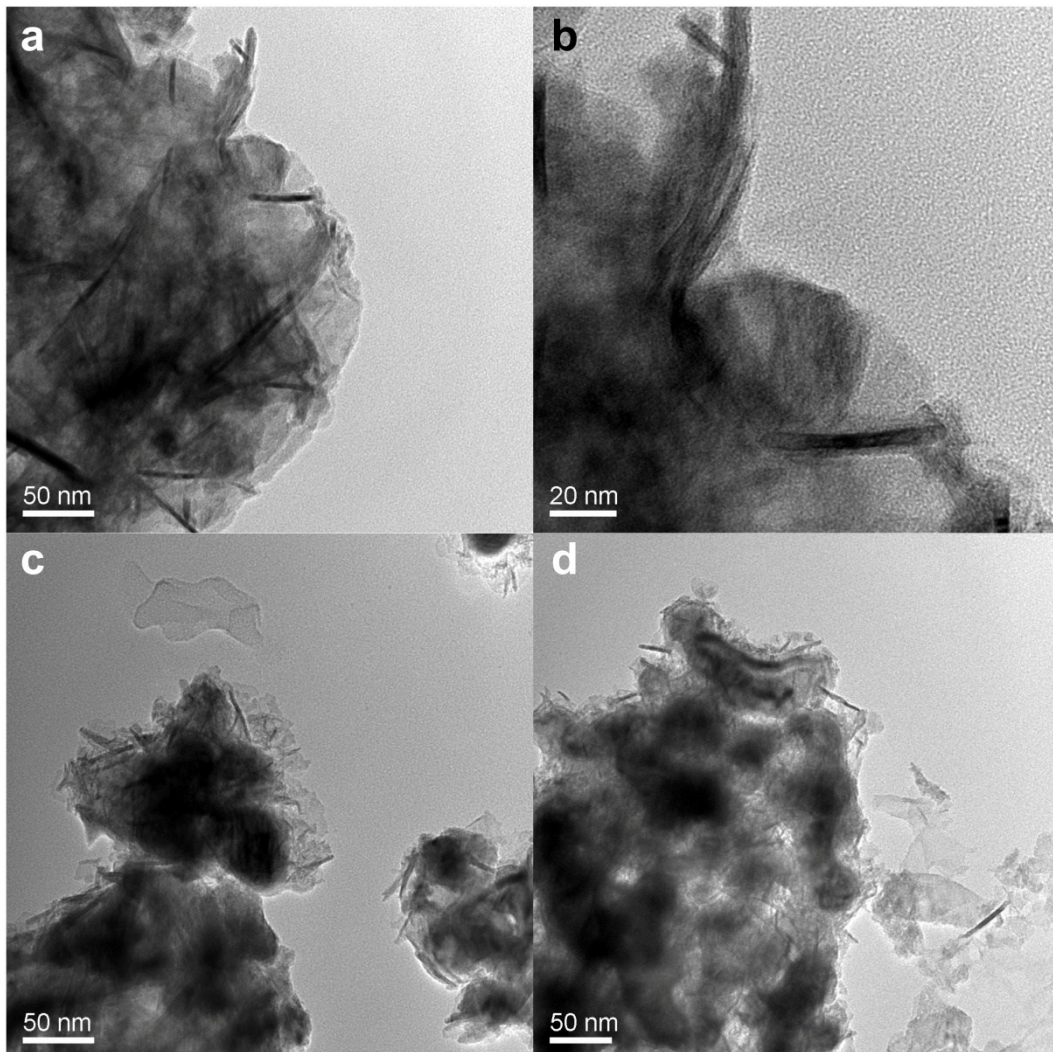


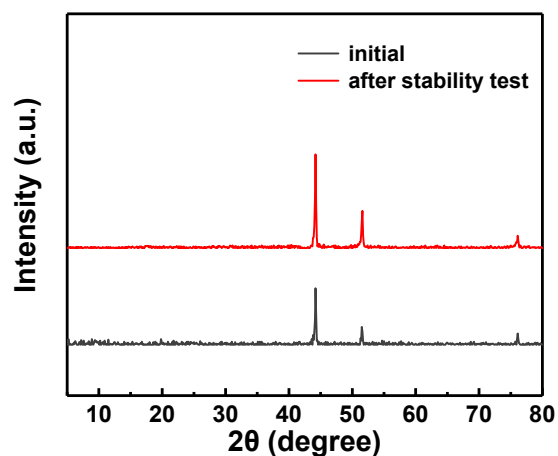
Figure S5. Electrochemical cyclic voltammetry curves of a) NF, b) NF@Co<sub>2</sub>(OH)<sub>2</sub>BDC, and c) NF/Co@NC/CoO<sub>x</sub>H<sub>y</sub> at different potential scanning rates, d) Plots of the capacitive currents as a function of scan rate of various samples.



**Figure S6.** Equivalent circuit for HER.



**Figure S7.** TEM image of NF/Co@NC/CoO<sub>x</sub>H<sub>y</sub> before a,b) and after c,d) 55h stability test.



**Figure S8.** XRD patterns of NF/Co@NC/CoO<sub>x</sub>H<sub>y</sub> before and after 55h stability test.

**Table S1** Co-containing HER electrocatalysts.

Materials	Overpotential at 10 mA cm <sup>-2</sup> (mV)	Overpotential at 50 mA cm <sup>-2</sup> (mV)	Overpotential at 100 mA cm <sup>-2</sup> (mV)	Electrolyte	Reference
NF/Co@NC/CoO <sub>x</sub> H <sub>y</sub>	51	188	297	1 M KOH	This work
Co-Co(OH) <sub>2</sub> /CC	230	336	390	1 M KOH	1
Co(OH) <sub>2</sub> @NF	255	330	445	1 M KOH	2
Co(OH) <sub>2</sub> NSs/NF	160	260	315	1 M NaOH	3
Co@NC	280	—	—	1 M KOH	4
Co@C-Se	190	260	340	0.5 M H <sub>2</sub> SO <sub>4</sub>	5
Co <sub>3</sub> O <sub>4</sub>	265	360	—	1 M KOH	6

## Reference

- [1] Z. Xing, C. Han, D. Wang, Q. Li, X. Yang, *ACS Catal.* 2017, **7**, 7131.
- [2] P. Guo, J. Wu, X. B. Li, J. Luo, W. M. Lau, H. Liu, X. L. Sun, L. M. Liu, *Nano Energy*, 2018, **47**, 96.
- [3] J. X. Feng, L. X. Ding, S. H. Ye, X. J. He, H. Xu, Y. X. Tong, G. R. Li, *Ad. Mater.* 2015, **27**, 7051.
- [4] H. Jin, J. Wang, D. Su, Z. Wei, Z. Pang, Y. Wang, *J. Am. Chem. Soc.* 2015, **137**, 2688.
- [5] W. Zhou, J. Lu, K. Zhou, L. Yang, Y. Ke, Z. Tang, S. Chen, *Nano Energy*, 2016, **28**, 143.
- [6] X. Yan, L. Tian, M. He, X. Chen, *Nano Lett.* 2015, **15**, 6015.