Supporting Information

Bimetallic metal-organic framework-derived cobalt selenide-based composites as bifunctional electrocatalysts for both hydrogen evolution and mono-alcohol oxidation

Lei Hu,[*a] Peng Zhong,[a] Jie Zhu,[a] Jiacheng Wang,[a] Yuchen Zheng,[a] Xiaoming Lin,[c] Yuyang Zhang[a] and Hao Yang[*b]

[a] School of Chemical and Environmental Engineering, Anhui Polytechnic University, Wuhu 241000, China. E-mail: hulei@ahpu.edu.cn

[b] School of Chemistry & Chemical Engineering, Guangxi University, Nanning 530004, China. E-mail: yanghao@gxu.edu.cn

[c] School of Chemistry, South China Normal University, Guangzhou 510006, China

Fig. S1 SEM image of CuCo-MOF.

Fig. S2 TEM image of Cu-$Co_{0.85}Se$@NC.

Fig. S3 XRD pattern of Co-MOF and CuCo-MOF.

Fig. S4 Cu 2p spectra of $Co_{0.85}Se$@NC and Cu-$Co_{0.85}Se$@NC materials.

Fig. S5 C 1s spectra of $Co_{0.85}Se$@NC and Cu-$Co_{0.85}Se$@NC materials.

Fig. S6 N 1s spectra of $Co_{0.85}Se$@NC and Cu-$Co_{0.85}Se$@NC materials.

Fig. S7 (a) HER long-term stability test for the Cu-$Co_{0.85}Se$@NC. (b) LSV curves of Cu-$Co_{0.85}Se$@NC before and after the stability test.

Fig. S8 XRD pattern of Cu-$Co_{0.85}Se$@NC before and after the HER stability test.

Fig. S9 (a) HER polarization curves, (b) HER Tafel slopes, (c) OER polarization curves and (d) OER Tafel slopes for Cu-$Co_{0.85}Se$@NC, Cu-$Co_{0.85}Se$@NC-1 and Cu-$Co_{0.85}Se$@NC-2 electrocatalysts.

Fig. S10 CV curves of (a) $Co_{0.85}Se$@NC and (b) Cu-$Co_{0.85}Se$@NC at different scan rates of 20, 50, 100, 150 and 200 mV s^{-1}.

Fig. S11 Nyquist plots of $Co_{0.85}Se$@NC and Cu-$Co_{0.85}Se$@NC electrodes.

Fig. S12 Performance comparison of the mono-alcohol oxidation reaction (M-AOR) with different concentrations of electrolytes.

Fig. S13 (a) CV curves at various scan rates from 20 mV s^{-1} to 200 mV s^{-1} for Cu-$Co_{0.85}Se$@NC. (b) The corresponding C_{dl} value comparison of Cu-$Co_{0.85}Se$@NC in 1.0 M KOH with and without methanol.

Fig. S14 (a) MOR long-term stability test for the Cu-$Co_{0.85}Se$@NC. (b) LSV curves of Cu-$Co_{0.85}Se$@NC before and after the stability test.

Fig. S15 Raman spectrum of $Co_{0.85}Se$@NC and Cu-$Co_{0.85}Se$@NC catalysts after HER test.

Fig. S16 The contact angles of Cu-$Co_{0.85}Se$@NC in (a) n-propanol, (b) isopropanol and (c) ethanol.

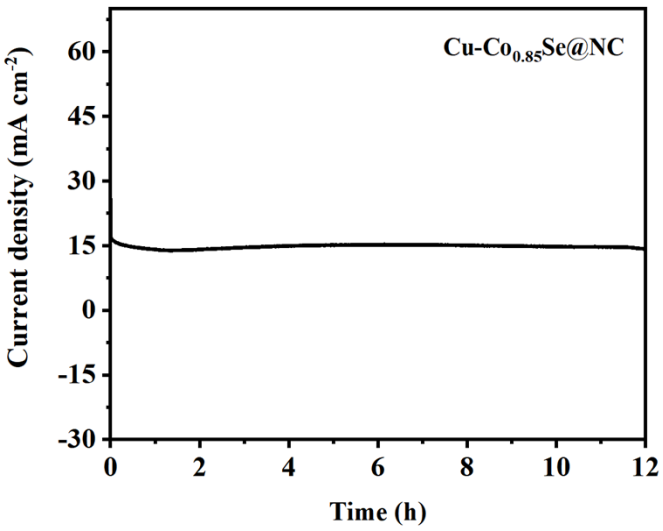

Fig. S17 The i-t curve of the Cu-$Co_{0.85}$Se@NC catalyst.