Electronic Supplementary Material (ESI) for Nanoscale.


# Supporting Information

# $Co_9S_8$ nanoparticles anchoring on nitrogen and sulfur dual-doped carbon nanosheets as highly efficient bifunctional electrocatalyst for oxygen evolution and reduction reactions

Can Wu [a], Yuhang Zhang [b], Duo Dong [a], Haiming Xie [b,*], Jinghong Li [a,*]

[a] Department of Chemistry, Key Laboratory of Bioorganic Phosphorus Chemistry & Chemical Biology, Beijing Key Laboratory for Analytical Methods and Instrumentation, Tsinghua University, Beijing 100084, China

[b] National & Local United Engineering Laboratory for Power Battery, Department of Chemistry, Northeast Normal University, Changchun 130024, China

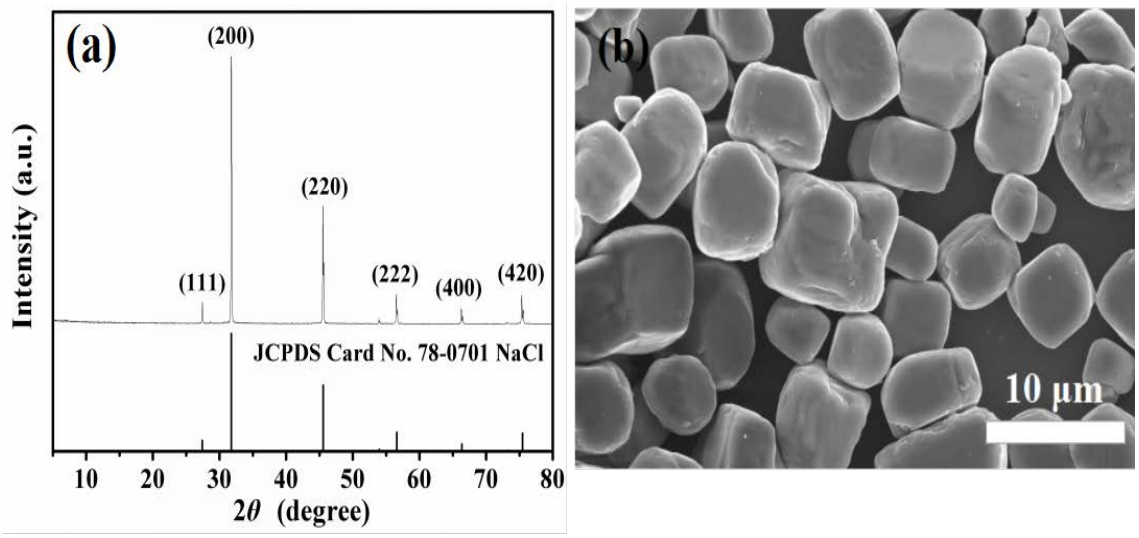


**Fig. S1.** (a) XRD pattern and (b) SEM image of the prepared NaCl crystals.

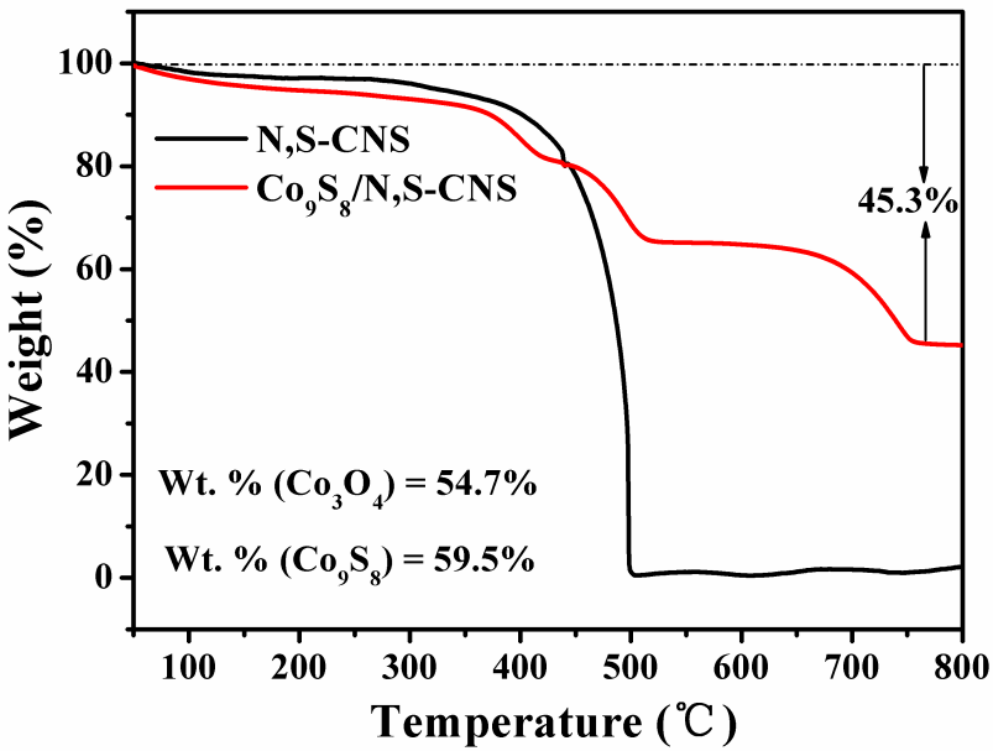


**Fig. S2.** TGA curves of $Co_9S_8$/N,S-CNS and N,S-CNS.

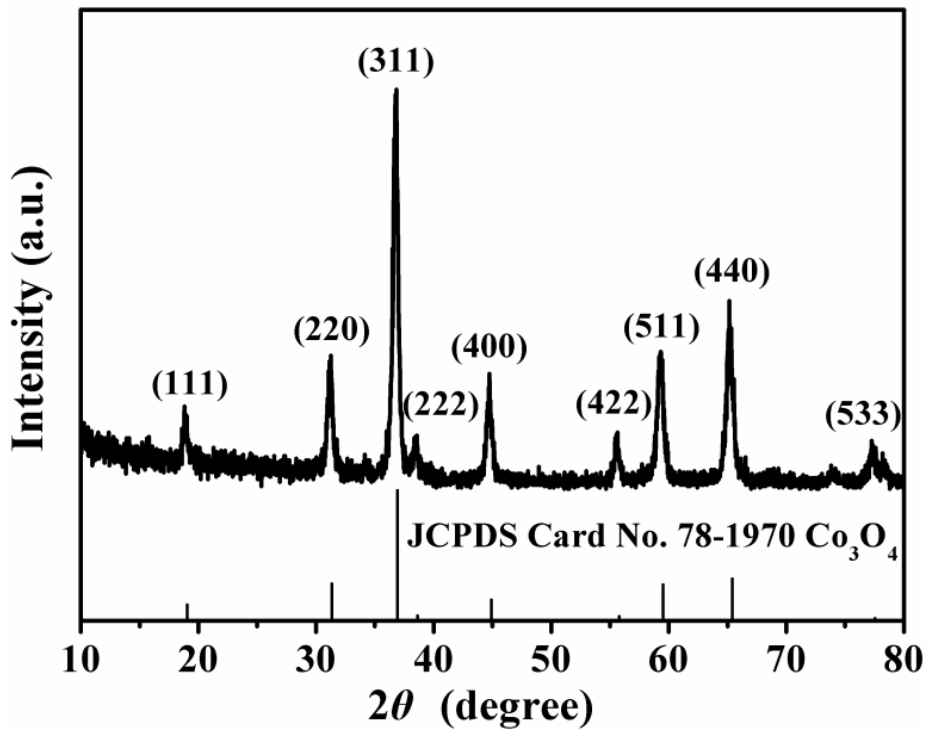


**Fig. S3.** XRD pattern of the $Co_9S_8$/N,S-CNS after TGA measurement.

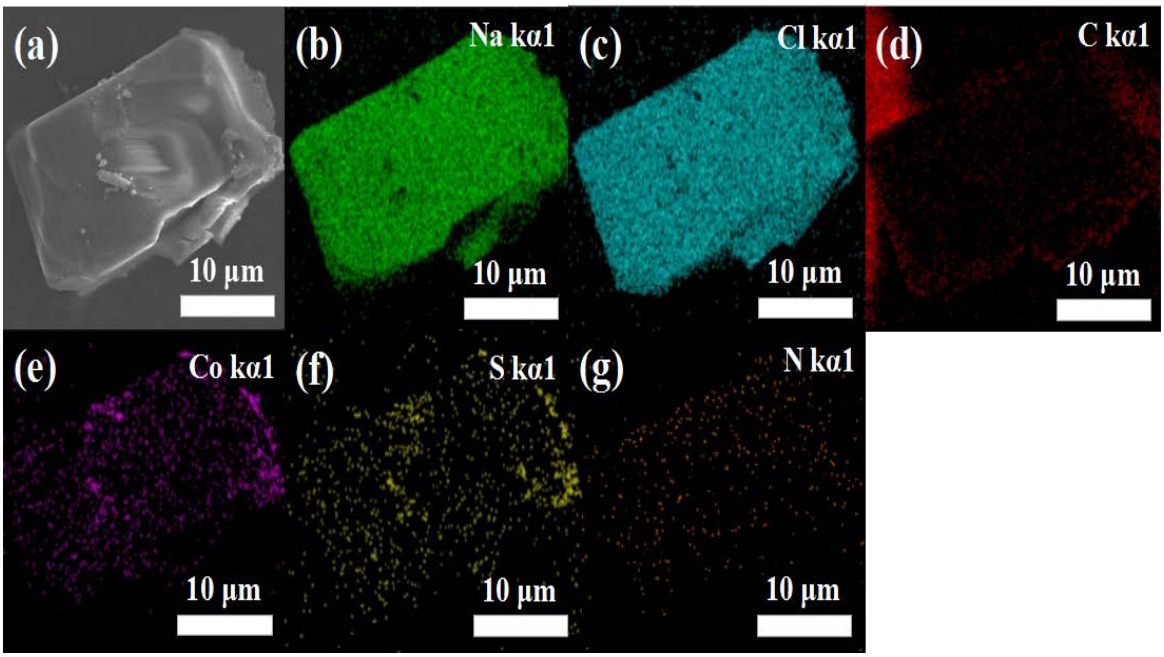


**Fig. S4.** SEM image and the corresponding element mappings of the $Co_9S_8$/N,S-CNS@NaCl.

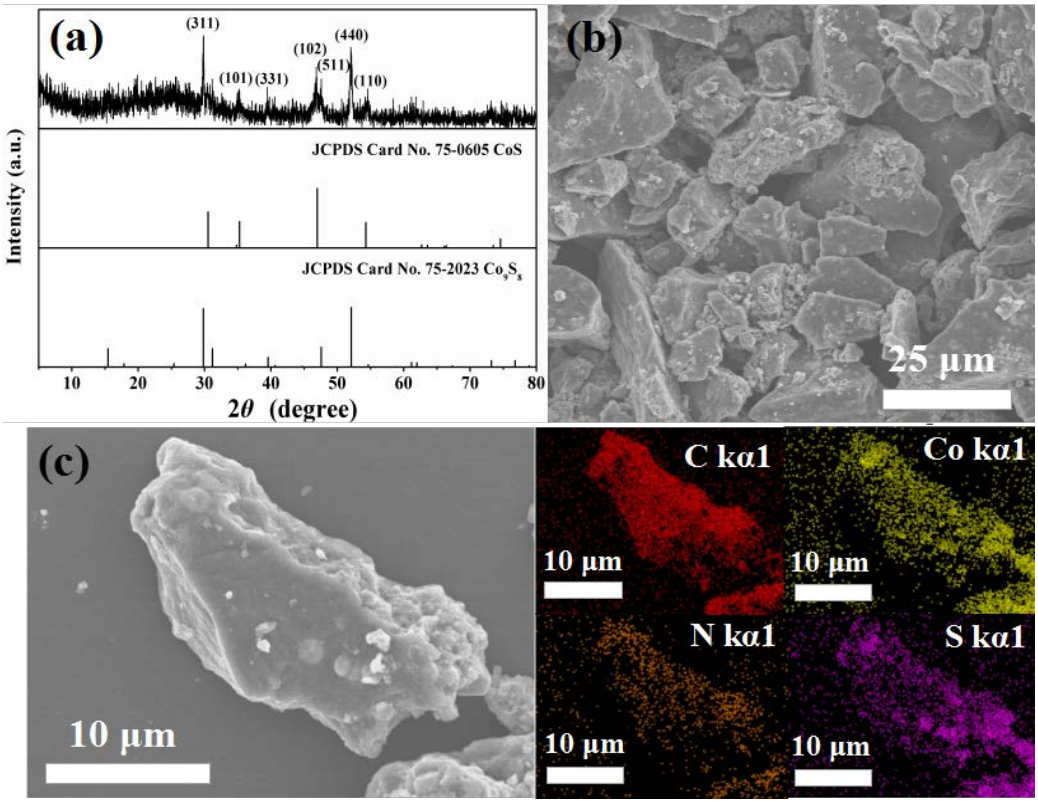


**Fig. S5.** XRD pattern (a), SEM image (b) and EDX element mapping images (c) of bulk $Co_9S_8$/C nanocomposite.

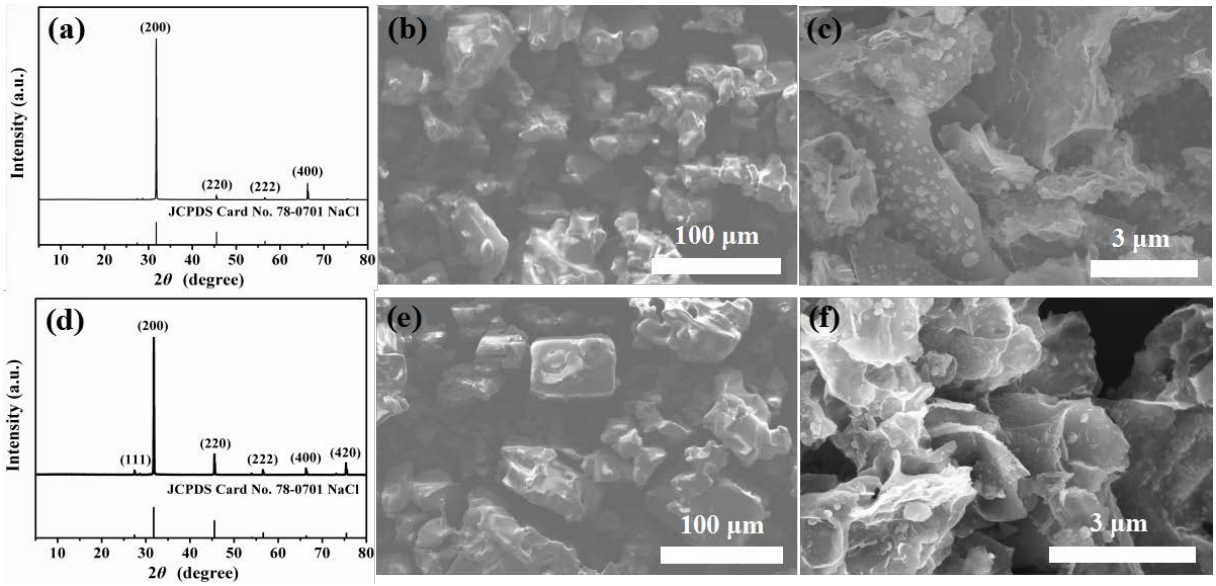


**Fig. S6.** XRD patterns of pristine NaCl powder (a) and NaCl powder prepared by vacuum distillation (d). SEM image of pristine NaCl powder (b) and NaCl powder powder prepared by vacuum distillation (e). SEM images of $Co_9S_8$/N,S-CNS using pristine NaCl powder (c) and NaCl powder prepared by vacuum distillation (f) as the templates.

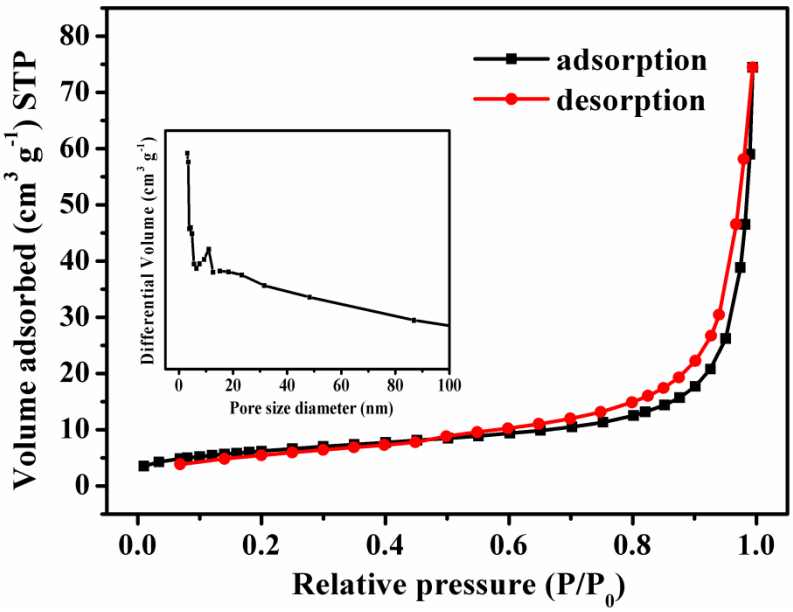


**Fig. S7.** BET adsorption-desorption studies and the pore size distributions (inset) of $Co_9S_8$/N,S-CNS.

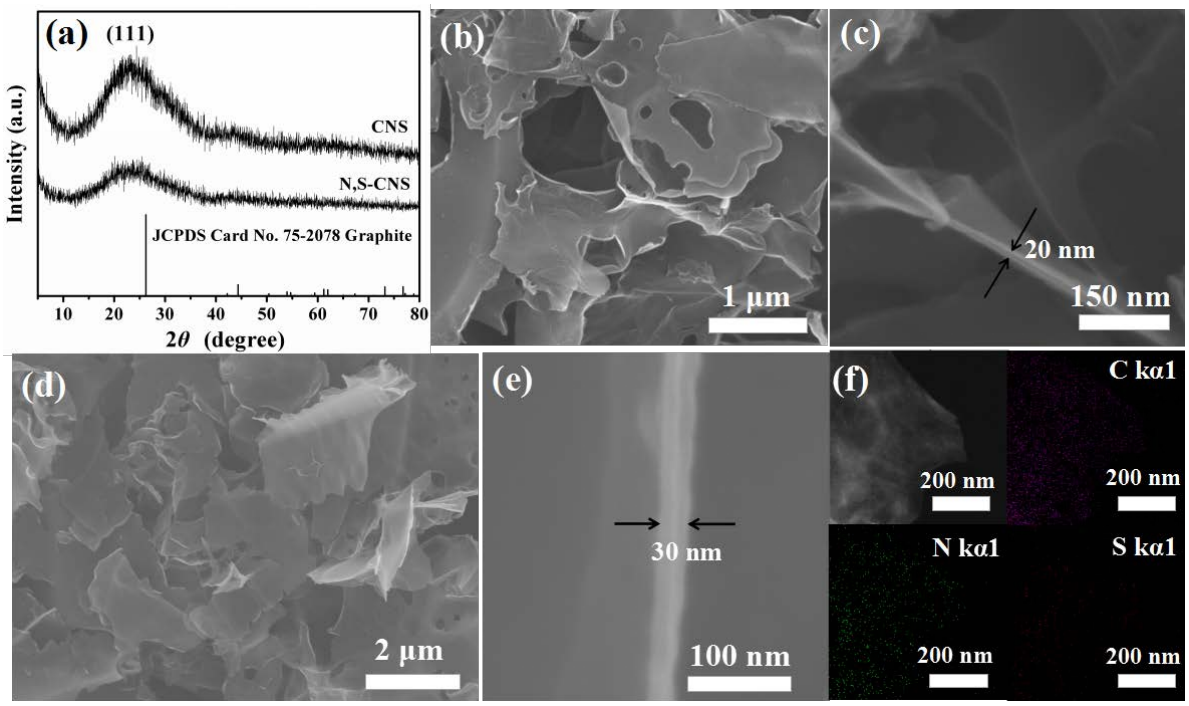


**Fig. S8.** (a) XRD patterns of CNS and N,S-CNS. (b) low- and (c) high-magnified SEM images of CNS. (d) low- and (e) high-magnified SEM images of N,S-CNS. (f) EDX element mapping images of N,S-CNS.

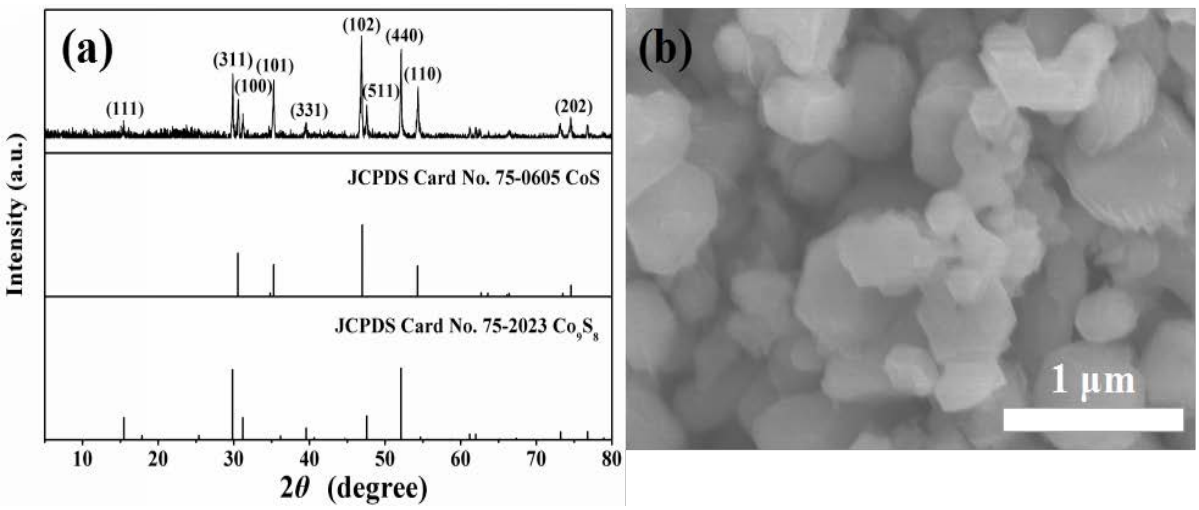


**Fig. S9.** (a) XRD pattern and (b) SEM image of cobalt sulfide nanoparticles.

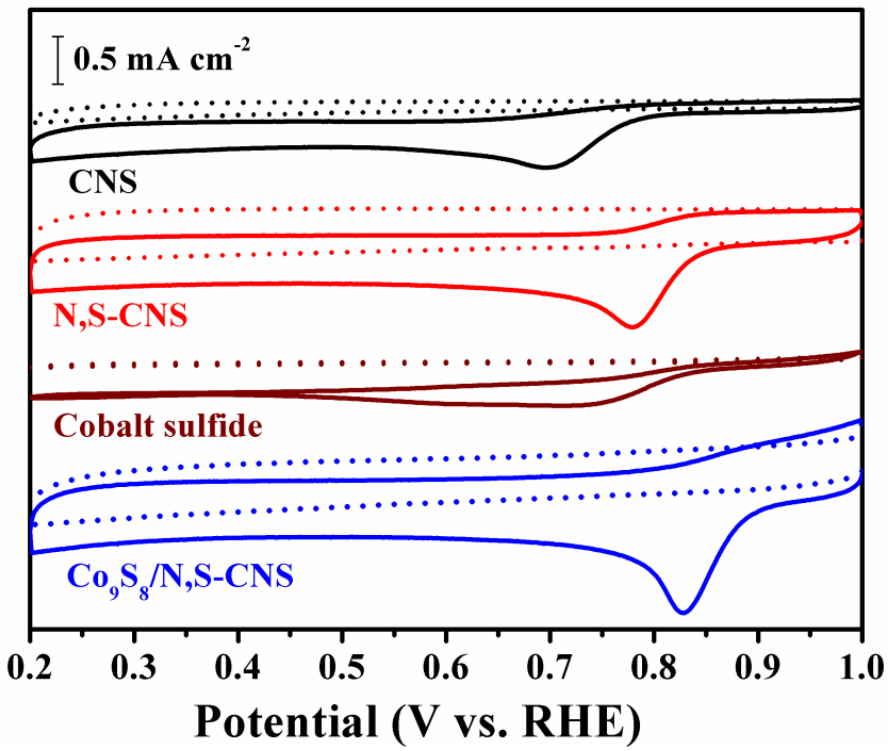


**Fig. S10.** CV curves of CNS, N,S-CNS, cobalt sulfide and $Co_9S_8$/N,S-CNS in a $N_2$-saturated (dashed line) or $O_2$-saturated (solid line) 0.1 M KOH solution.

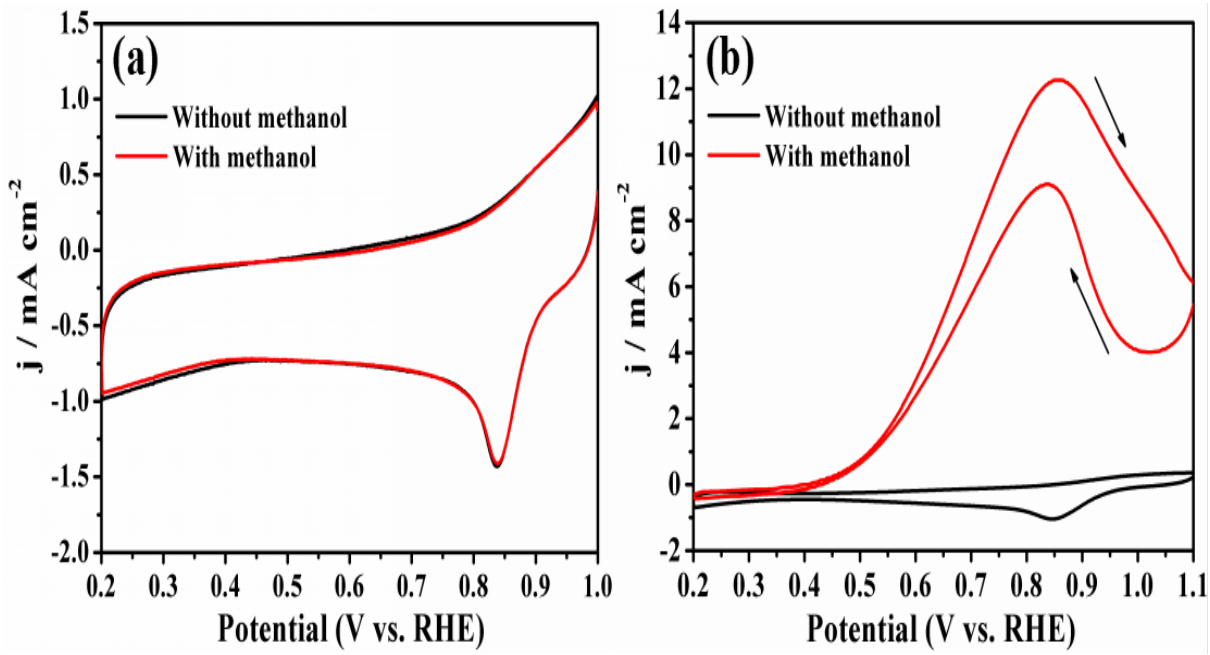


**Fig. S11.** CV curves of $Co_9S_8$/N,S-CNS (a) and Pt/C (b) in $O_2$-saturated KOH solution (0.1 M) and $O_2$-saturated mixture solution (KOH, 0.1 M; Methanol, 3 M) at a scan rate of 10 mV $s^{-1}$.