Electronic Supporting Informations

Direct growth of $NiCo_2S_x$ nanostructures on stainless steel with enhanced electrocatalytic activity for methanol oxidation

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Experimental section

Direct growth of $NiCo_2S_x$ nanostructures on SS substrate

Before electrodeposition, SS substrates were cleaned in an ultrasonic bath in dilute HNO_3, acetone and water sequently. During the electrodeposition process, SS was used as working electrode, Pt wire and saturated calomel electrode (SCE) were used as counter and reference electrode. Co-Ni double hydroxide (Co-Ni LDHs) were electrodeposited on SS substrate in a aqueous electrolyte with 0.02 M $Co(NO_3)_2$ and 0.01 M $Ni(NO_3)_2$ at a deposition potential of -1.0 V and deposition time of 30 min. After cleaned with water, the Co-Ni LDHs/SS were inserted into a 0.2 M Na_2S solution. Finally, after vulcanized overnight, the Co-Ni LDHs were fully converted into $NiCo_2S_x$. The $NiCo_2S_x$ on ITO substrate were synthesized by the same method using ITO as substrate. The $NiCo_2S_x$ on ITO were used for cross-sectional SEM characterization because the ITO is fragile, in the process of obtaining the cross section, the morphology of the Ni-Co LDHs can be fully preserved. The NiS_x or the CoS_x were synthesized by the same method using $Ni(NO_3)_2$ or $Co(NO_3)_2$ as Ni source or Co source.

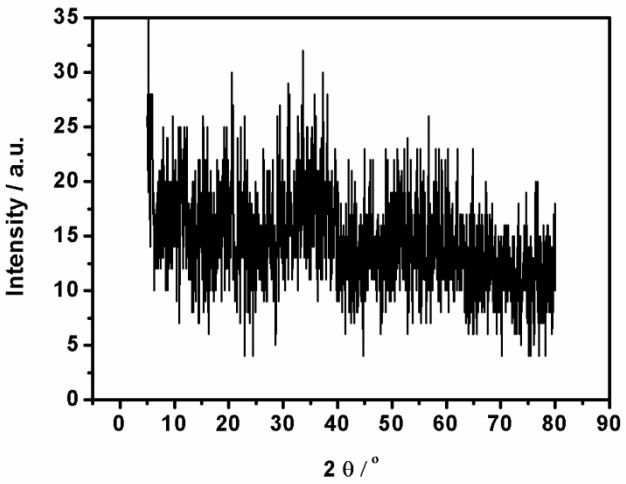

Fig. S1 XRD pattern of $NiCo_2S_x$ after vulcanization before calcination.

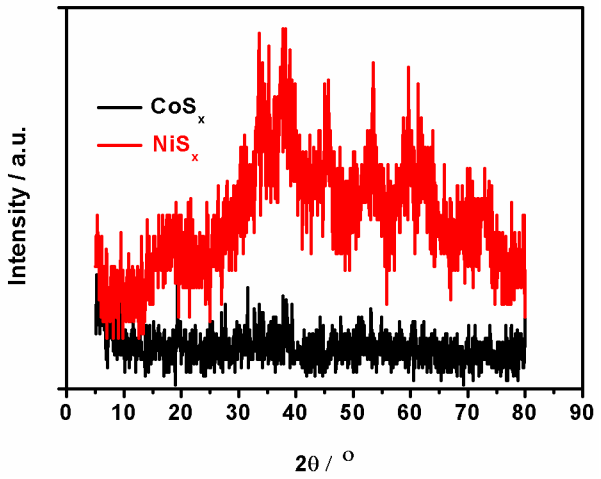

Fig. S2 XRD patterns of NiS_x and CoS_x.

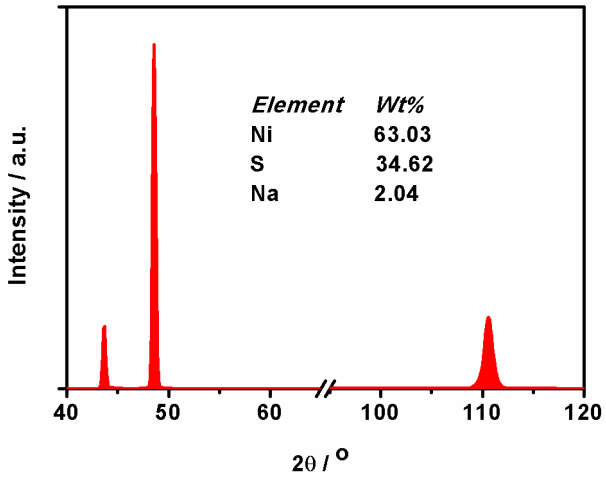

Fig. S3 XRF pattern of NiS_x.

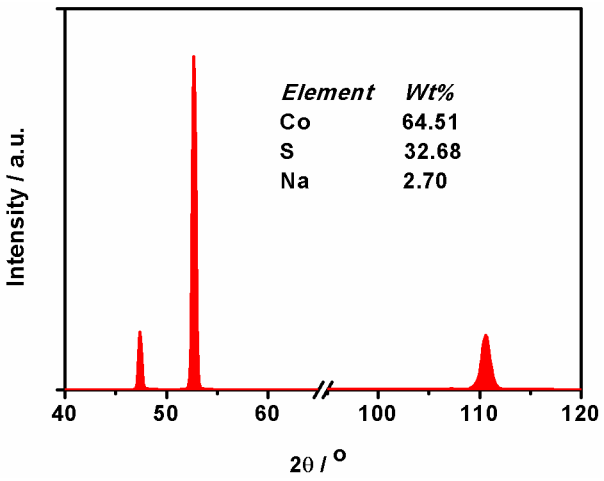

Fig. S4 XRF pattern of CoS_x.

The methanol oxidation performance on Co-Ni LDHs/SS and blank SS were investigated by CV and chronoamperometry methods. The results were shown in Fig S5, S6 and S7.

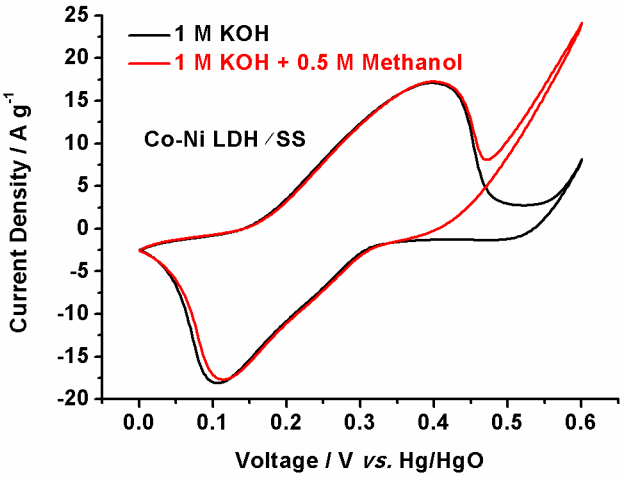

Fig. S5 CV curves of Co-Ni LDHs/SS electrode in 1 M KOH electrolyte without (black) and with (red) 0.5 M methanol at a scan rate of 10 mV s^{-1}.

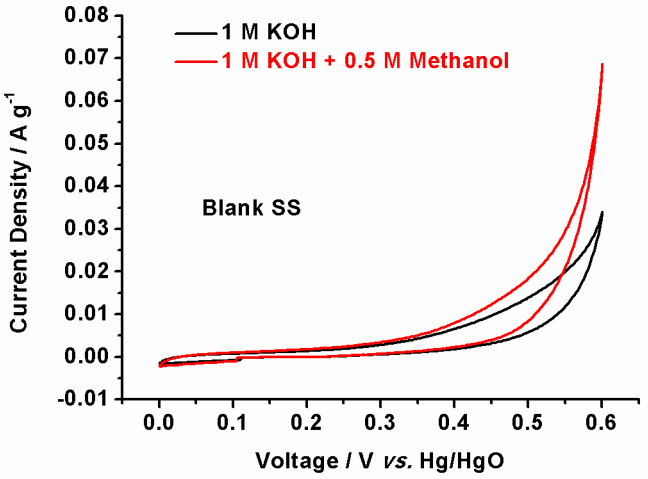

Fig. S6 CV curves of blank SS electrode in 1 M KOH electrolyte without (black) and with (red) 0.5 M methanol at a scan rate of 10 mV s^{-1}.

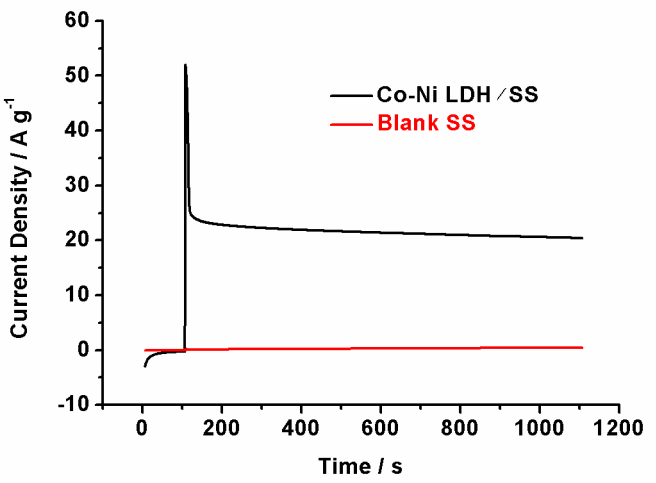

Fig. S7. Chronoamperometry curves of Co-Ni LDHs/SS (black) and blank SS (red) electrode in 1 M KOH electrolyte with 0.5 M methanol at 0 V (0-100 s) and 0.6 V (101-1100 s).