

**Hierarchical Ni-Fe layered double hydroxide/MnO<sub>2</sub> sphere  
architecture as an efficient noble metal-free electrocatalyst for  
ethanol electro-oxidation in alkaline solution**

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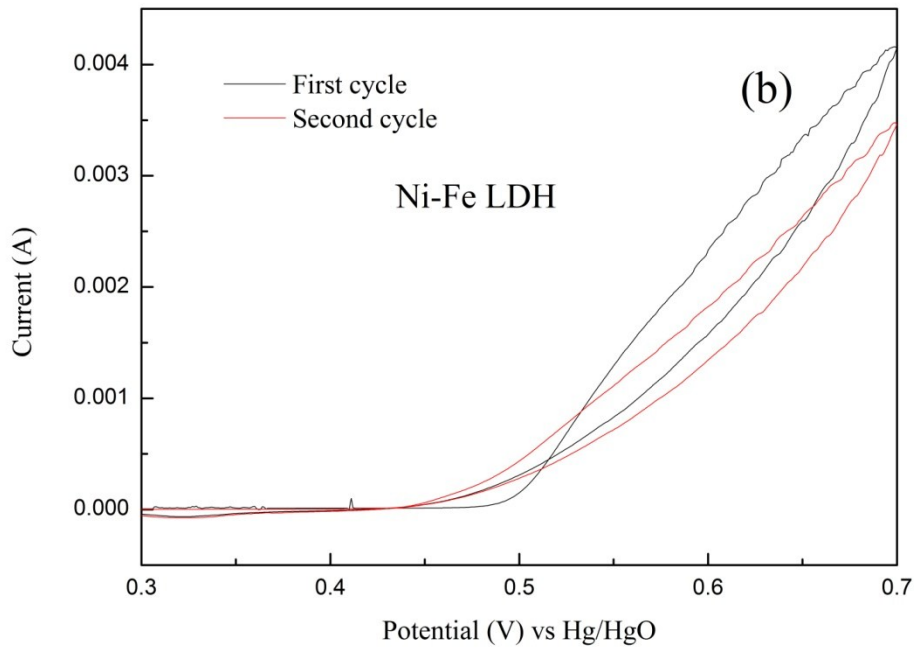
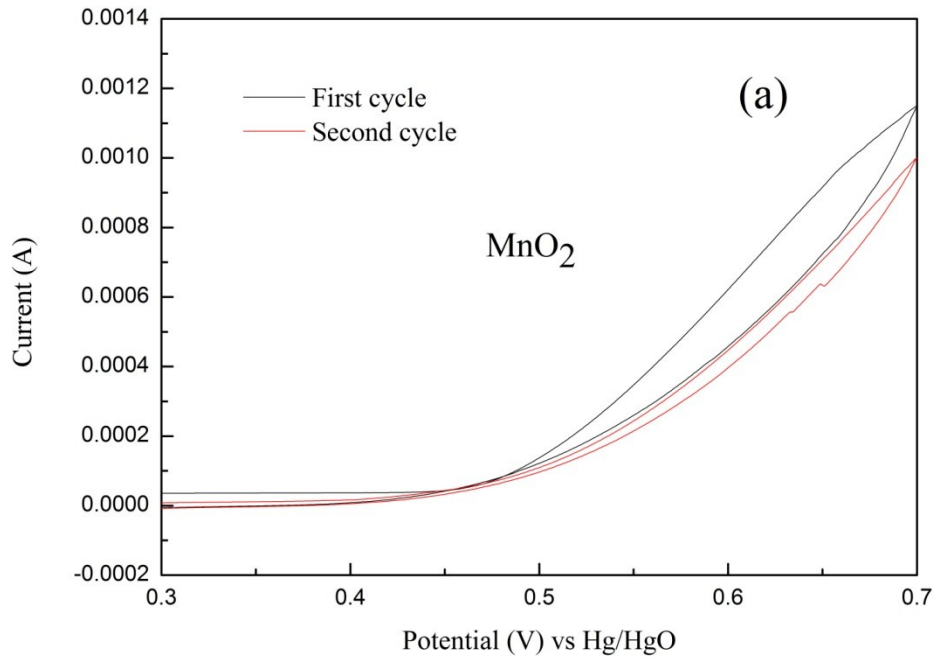
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Supporting information

1. Experimental

CO stripping experiments were performed as follows: after purging the solution with N<sub>2</sub> for 20 min, gaseous CO was bubbled for 15 min to form CO adlayer on catalysts while maintaining potential at 0.3 V. Then excess CO in solution was purged with N<sub>2</sub> for 20 min and CO stripping voltammetry was recorded in 1 M KOH solution at 50 mV s<sup>-1</sup>.

2. Results and discussion



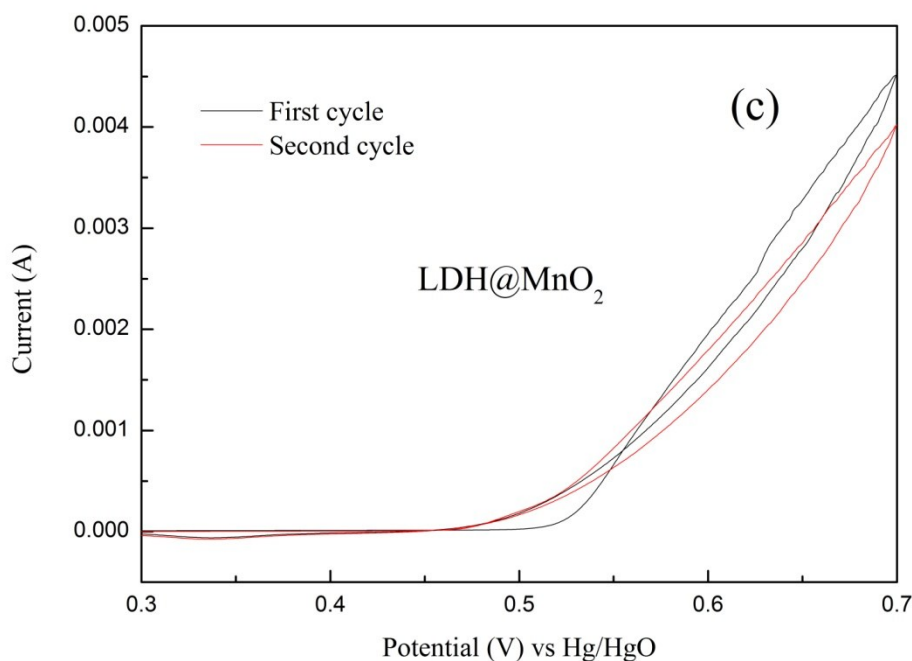


Fig. S1 (a) CO stripping curves on  $\text{MnO}_2$  (a), Ni-Fe LDH (b) and LDH@ $\text{MnO}_2$  (c) recorded in 1 M KOH solution

To have a deep insight into the synergistic effect between Fe-Ni LDH and the  $\text{MnO}_2$ , the CO stripping voltammograms were recorded, as shown in Fig. S1. As shown in Fig. S1(a), it is clear that there is no obvious difference between the first and second CV curves from CO stripping voltammograms. Therefore, it manifested that the CO cannot be adsorbed on  $\text{MnO}_2$ . Comparing the CO stripping CV curves from Ni-Fe LDH and LDH@ $\text{MnO}_2$  catalysts, as shown in Fig. S1(b) and (c), no great differences was found no matter in magnitude of current, or in CV shapes. Furthermore, the synergistic effect between Fe-Ni LDH and the  $\text{MnO}_2$  cannot be explained by CO stripping voltammograms. The main reason for the synergistic effect between Fe-Ni LDH and the  $\text{MnO}_2$  may be attributed to the facile adsorption of  $\text{OH}_{\text{ads}}$  species onto  $\text{MnO}_2$  [1]. Therefore, it is inferred that  $\text{MnO}_2$  could increase the

concentration of  $\text{OH}_{\text{ads}}$  species on Ni-Fe LDH surface, and these  $\text{OH}_{\text{ads}}$  can react with  $\text{C}_{1\text{ad}}$  intermediate species to produce  $\text{CO}_2$  or water soluble products, releasing the active sites on LDH for further electrochemical reaction [2-5].

## Reference

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