One step synthesis of CoAl- layered double hydroxides electrode and its pseudo-capacitive characteristics

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Abstract:

In this study, the CoAl-LDHs nanosheet array on titanium foam was synthesized by a simple hydrothermal method. The crystalline CoAl-LDHs phase in titanium form is found to be highly active for oxygen evolution reaction in alkaline solutions. In the electrocatalysis experiment with the obtained CoAl-LDH electrode, the resulting electrode exhibits higher electrocatalytic activity and stability for oxygen evolution than commercial precious metal catalysts.

Keywords: Hydrotalcite, electrocatalyst, pseudo-capacitance.

1. Introduction

Hydrotalcites are a class of anionic layered compounds, also known as Layered Double Hydroxides (LDHs). Its properties include a high anion exchange capacity comparable to an anion exchange resin.[1] LDHs are currently used in a variety of technologies and materials required for life, such as catalytic, catalyst precursors, electroactive and photoactive materials.[1-3] Supercapacitor (SC) is an electrocatalytic capacitor whose capacity is typically 20 to 200 times higher than conventional capacitors; supercapacitors have higher power than batteries and are very popular for use in portable electronic devices. In the electrocatalytic capacitance system has a lower specific capacitance and energy density, so re-use of hybrid materials to increase its electrocatalytic capacitance and energy density is more appropriate, the use of electrode surface electrocatalytic active species redox reaction is the pseudo- capacitance. [4]

2. Experimental

In this study, the CoAl-LDHs nanosheet array on titanium foam was synthesized by a simple hydrothermal method. Firstly, the aqueous solution and the titanium foam (about 2 cm × 3 cm) were transferred to a Teflon-lined stainless-steel autoclave, which was sealed, kept at different temperatures (80,100,120,and 140°C) for 12 hours. The CoAl-LDHs nanosheet array was synthesize by co-precipitation, which resulted in a pink coating on the surface of the titanium foam. The corresponding sample was designated as CoAl-LDHs-X (X = 80, 100,120 and 140), where X means the hydrothermal temperatures.

Then films were characterized by SEM, TEM for its microstructures and morphologies. All the electrocatalysis measurements were performed on an electrochemical workstation in 1M NaCl aqueous solution at room temperature. They were experimented for electrocatalytic properties by CV.

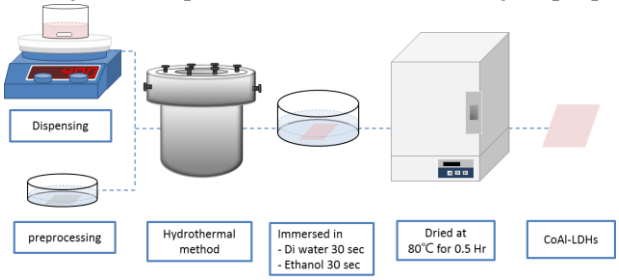

Figure 1. Experimental flow chart

3. Results and discussion

Fig. 2.a. is a titanium substrate after 80,100,120 and 140 ℃ for 12 hours of hydrothermal synthesis of CoAl-LDHs photo.Through this one-step hydrothermal method, we successful obtained the electrode of

CoAl-LDH. Fig. 2.b. SEM image shows that the CoAl-LDHs appearance changed by different hydrothermal temperatures.

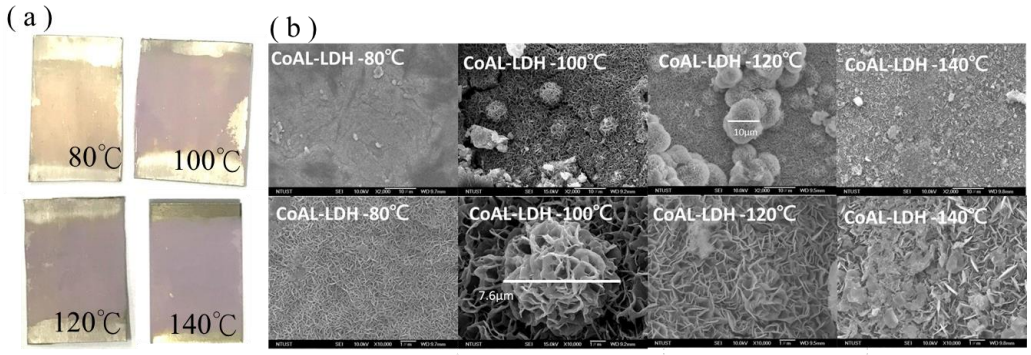

Figure 2. (a) CoAl-LDH photo by different hydrothermal temperatures and (b) SEM images of CoAl-LDH film

Electrocatalysis characterization of the different hydrothermal temperature CoAl-LDHs are presented in Fig. 3. showed the cyclic voltammogram (CV) curves at scan rate of 1 mV/s with a potential range of -0.5 to 0 V in 1 M NaCl solution.

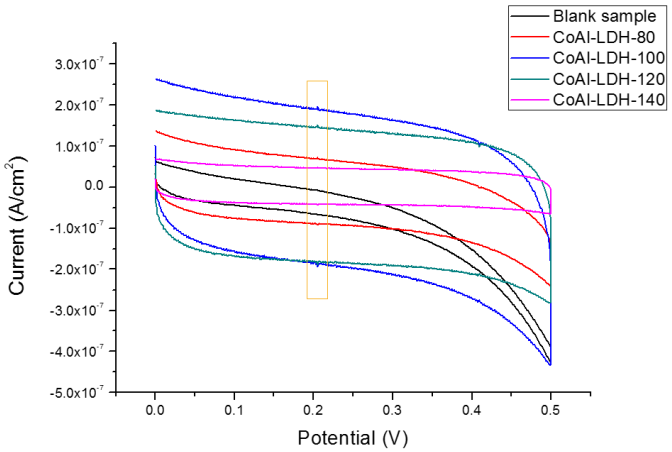

Figure 2. Electrocatalyst characterization. The cyclic voltammogram of the different hydrothermal temperature CoAl-LDHs -(80, 100, 120 and 140).

CoAl-LDHs from the above photos and SEM images can be seen cobalt and aluminum ion aqueous solution can be precipitated on the titanium plate. In the cyclic voltammetry part , as shown in Fig. 3 yellow box there are obvious wave front appears, which can be CoAL-LDHs electrocatalytic pseudo-capacitance there will be.

4. Conclusions

CoAl-LDHs, the newer type of pseudo-capacitance material in many types of hydrotalcites, grow directly on the substrate by hydrothermal deposition in a vertical manner. The pseudo-capacitance of the novel nanostructured material didn`t need the else additional adhesive, which substantial increase in its electrocatalytic properties. In addition, the electrocatalytic produced by this research institute are very simple, low-cost and environmentally friendly, and therefore will be of outstanding help and development in the design and manufacture of energy storage applications in the future.

References

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