

Synthesis of a gold cluster-modified LDH nanosheet electrocatalyst for oxygen evolution reaction

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Environmentally-friendly H₂ fuel can be produced in water electrolysis using renewable energy. Oxygen evolution reaction (OER) accompanied with 4-electron oxidation of water is a key process in water electrolysis. However, this process is kinetically sluggish. Therefore, many efforts have been devoted to develop highly active OER electrocatalysts for efficient water electrolysis. Recently, it was reported that nanosheets exfoliated from layered double hydroxide (LDH) composed of Ni²⁺ and Fe³⁺ showed considerably high activities for OER [1]. Considering that LDH nanosheets (LDH-ns) composed of an insulating hydroxide layer have low electron conductivity, improvement of its conductivity is required to achieve higher performance as an electrocatalyst. In this study, we tried to enhance catalytic activities of LDH-ns by decorating Au clusters on the nanosheets, which is expected to enhance electron transfer between nanosheets and an electrode substrate. We first prepare Au cluster modified NiFe-LDH nanosheets (Au/LDH-ns) and examine its performances in OER.

NiFe-LDH was synthesized by hydrothermal method and colloidal Au clusters were prepared in DMF as reported previously [2,3]. Carbonate ions in NiFe-LDH were exchanged to perchlorate ions, and the perchlorate ion-intercalated sample was dispersed in formamide, resulting in formation of colloidal LDH-ns solution. Au/LDH-ns was prepared by mixing colloidal solutions of the LDH-ns and Au clusters. Dispersion of Au colloid on LDH-ns was confirmed by STEM observation. Fig. 1 shows *iR*-corrected polarization curves of LDH-ns, Au clusters and Au/LDH-ns electrocatalysts in 1 M KOH aqueous solution. The Au/LDH-ns showed much higher activity than that of LDH-ns while the Au clusters showed negligible

activity, indicating that application of Au clusters to LDH-ns significantly improved catalytic activities. Fig. 2 shows the effects of the amount of Au on overpotential at 10 mA/cm² and Tafel slope tendency of Au/LDH-ns. Performances of the Au/LDH-ns electrocatalyst depended on the amount of Au clusters and Au/LDH-ns with 2 wt% Au clusters showed the lowest overpotential (0.26 V) and Tafel slope (35 mV/dec).

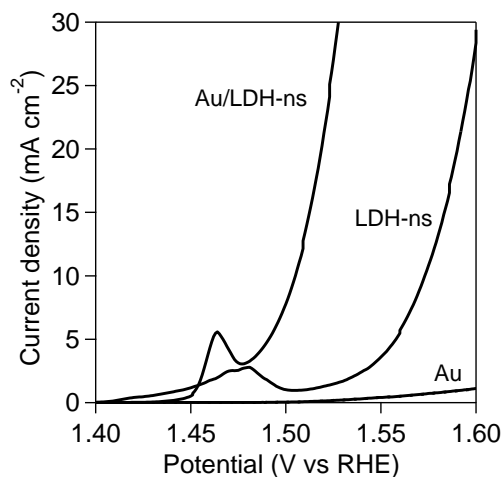


Fig.1 *iR*-corrected polarization curves of LDH-ns, Au clusters and Au/LDH-ns in 1 M KOH aqueous solution.

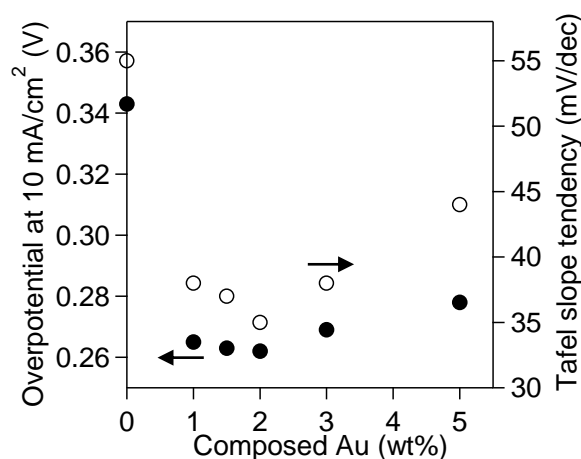


Fig.2 Overpotential at 10 mA/cm² (closed) and Tafel (open) slope on Au/LDH-ns with various loading amounts of Au.

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