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Investigating the Oxygen Evolution Reaction Mechanism of Zinc (Un) substitution Iron Cobaltite Spinel under Alkaline Electrolyte via Ambient Pressure X-ray Photoelectron Spectroscopy

Content

Developing low-cost and highly efficient catalysts for energy storage and conversion devices is one of the most important topics to overcome the global environmental and energy crisis nowadays. Oxygen evolution reaction (OER) plays a key role in the anode part of electrochemical energy storage and conversion devices. Understanding the reaction mechanism of OER is a significant way to improve and enhance the overall performance of those electrochemical devices. Ambient pressure X-ray Photoelectron Spectroscopy (APXPS) has been demonstrated to investigate the reaction mechanism on the surface of a catalyst in a closely ambient environment effectively, allowing investigation of liquid-solid interfaces by using homemade electrolytic cells during electrochemical reactions. Here, the selection of contributed metal substitution shows increased cation vacancies to enhance OER activity enormously. The zinc substitution iron cobaltite-based spinel structure ($\text{Zn}_x\text{Fe}_{1-x}\text{Co}_2\text{O}_4$) with a different amount of Zn substitution ($0 < x < 0.6$ with steps of 0.2) supported on nickel foam (NF) was synthesized by a hydrothermal method and served as an electrocatalyst in alkaline solution. The $\text{Zn}_{0.4}\text{Fe}_{0.8}\text{Co}_2\text{O}_4/\text{NF}$ electrocatalyst shows great OER activity, which achieves an overpotential of 300 mV at a current density of 50 mA cm^{-2} under 1M NaOH. Furthermore, in-situ/operando APXPS presents the highest Co (IV) percentage in Co 2p spectra, approximately 56%, and an increase of superoxide on the surface in O 1s spectra. We proposed that the Co (IV) and superoxide species are the important intermediates in the OER for iron cobaltite-based spinel structure catalyst to produce oxygen. More detailed results will be presented in this meeting.

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