

Synthesis of Free-Standing Spinel FeCo₂S₄ Nanoplates toward Improvement of Electrocatalytic Oxygen Evolution from Water Splitting

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Abstract

In this work, a system of FeCo₂S₄-catalyzed oxygen evolution reaction (OER) is studied. The spinel FeCo₂S₄ nanocatalysts are synthesized by a two-step hydrothermal method on a Ni foam (NF) by vulcanizing Fe-Co precursors with different [Na₂S], leading to the products of excavated nanospheres (ENSs). The ENSs have the advantages of highly exposed surface area and high dispersity on the Ni foam. The FeCo₂S₄/NF catalyst is then used as a working electrode for OER in an electrochemical system including Pt, Ag/AgCl, and 1 M NaOH as counter, reference electrodes, and electrolyte, respectively. The catalytic results represent that the performance of FeCo₂S₄/NF in OER is correlative with the vulcanized ENS surfaces made by different [Na₂S] where 0.1 M is the concentration to reach lowest OER overpotential. Besides, the structures of FeCo₂S₄ ENSs are stable after 12-hour OER durability test. Only the surface states of them are changed largely due to drastic leaching of sulfur. The phenomenon implies sulfur a key role on the surface instead of in the structure of an ENS for OER. In the results of potential-dependent XRD and XAS with the 0.1 M-FeCo₂S₄/NF electrode, the dominant pathway for FeCo₂S₄-catalyzed water splitting is via the formation of MOOH followed by release of O₂. Hence, the reason of S-assisted OER is due to optimization of conductivity to benefit the MOOH generation. This finding which was presented in few reports is now bringing a proof to confirm the absence of MSOH during the OER.

Keywords - spinel, hydrothermal method, self-assembled, bifunctional electrocatalyst, overall water-splitting

References

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