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Prussian blue analog-derived Fe-Co-P as excellent electrocatalyst for oxygen evolution reaction

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Due to the environmental deterioration caused by overuse of fossil fuels and generating large amounts of greenhouse gases, it is significant to develop efficient and economical techniques for producing green and renewable energy sources [1]. Among the competitive candidates, the rapid progress in hydrogen and oxygen production via electrochemical water splitting (ECWS) has made it a promising solution [2]. ECWS is composed of oxygen evolution reaction (OER) and hydrogen evolution reaction (HER). However, the sluggish kinetics of OER due to its four-electron transfer process is still a challenge, which greatly limits the electrocatalytic efficiency [2]. In addition to, noble metal-based oxides, such as RuO_2 and IrO_2, are recognized as state-of-the-art OER electrocatalysts [3] and since these catalysts are expensive, thus extensive research is being done to replace them. In this regard, transition metal salts, organometallic compounds, metal-organic frameworks (MOFs), polyoxometalates (POMs), Prussian blue (PB) and other nanostructures have been investigated. Among them, PB and Prussian blue analogs (PBAs) are of special interest, as they are excelent catalysts and precursor materials due to their easy, robust and cost-effective synthesis, highly porous structure and designed morphology, improved electron transport and accessible catalytic sites [1]. The PB, termed ferric ferrocyanide, is a polynuclear complex including transition metal (Fe) and cyanide group (CN) and as a MOF has had industrial applications since the 18th century, which initial structural forms discovered by Keggin and Miles. Their proposed form showed that PB comprises iron ions including ferrous (Fe^{2+}) and ferric (Fe^{3+}) located at the corners of a cube which is linked by cyanide ligands with the general formula of $Fe^{3+}{}_4[Fe^{2+}(CN)_6]_3$, their assembly can be achieved by mixing ferric or ferrous with hexacyanoferrate ions and different oxidation states of iron [4]. Which, PB-based catalysts it has shown broad application in different disciplines especially OER based on publications since 1986. Herein, FeCoP nanocages have been obtained from FeCo-PBA nanocube precursor via a facile phosphorization route. The porous hollow structure and unique multi-void interior provide exposed active sites and a large surface area. In the FeCoP catalyst, both P and metals (Fe and Co) serve as active sites, and the synergism between them induces an optimized electronic structure. Finally, these nanocage structures showed good catalytic activity for OER.

Keywords:Prussian blue , Water splitting, Oxygen evolution reaction.

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