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Graphene-reinforced Metal-organic Framework Derived Cobalt Sulfide/Carbon Nanocomposites as Efficient Multifunctional Electrocatalysts

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Abstract : Developing cost-effective electrocatalysts for oxygen reduction reaction (ORR), oxygen evolution reaction (OER) and hydrogen evolution reaction (HER) is vital in energy conversion and storage applications. Herein, we report a simple method for the synthesis of graphene-reinforced cobalt sulfide/carbon nanocomposites and the evaluation of their electrocatalytic performance for typical electrocatalytic reactions. Nanocomposites of cobalt sulfide embedded in N, S co-doped porous carbon and graphene (CoS@C/Graphene) were generated via simultaneous sulfurization and carbonization of one-pot synthesized graphite oxide-ZIF-67 precursors. The obtained CoS@C/Graphene nanocomposite was characterized by X-ray diffraction, Raman spectroscopy, Thermogravimetric analysis-Mass spectroscopy, Scanning electronic microscopy, Transmission electronic microscopy, X-ray photoelectron spectroscopy and gas sorption. It was found that cobalt sulfide nanoparticles were homogenously dispersed in the in-situ formed N, S co-doped porous carbon/Graphene matrix. The CoS@C/10Graphene composite not only shows excellent electrocatalytic activity toward ORR with high onset potential of 0.89 V, four-electron pathway and superior durability of maintaining 98% current after continuously running for around 5 hours, but also exhibits good performance for OER and HER, due to the improved electrical conductivity, increased catalytic active sites and connectivity between the electrocatalytic active cobalt sulfide and the carbon matrix. This work offers a new approach for the development of novel multifunctional nanocomposites for the next generation of energy conversion and storage applications.

Keywords : MOF derivative, graphene, electrocatalyst, oxygen reduction reaction, oxygen evolution reaction, hydrogen evolution reaction
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