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Multifunctional electrocatalysts derived from conducting polymer and metal organic framework complexes

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Abstract

High cost, scarcity, and detrimental environmental effect of the noble-metal based catalysts have prompted the seek of less expensive, more benign, and earth abundant substitutes for energy conversion and storage. Here, we demonstrate a novel multifunctional electrocatalyst constructed by pyrolysis of the complex of polyaniline (PANI) and metal organic framework [Co-based MOF; zeolitic imidazolate framework (ZIF-67)]. The resultant PANI/ZIF-67 complex unveiled excellent electrocatalytic activities towards oxygen reduction reaction (ORR), oxygen evolution reaction (OER), and hydrogen evolution reaction (HER) in alkaline medium. It was found that the catalytic activities of the PANI/ZIF-67 complex towards ORR, OER and HER could be tuned by simple changing the weight ratio of PANI to the MOF. Further, we tested the material as an air electrode for a primary zinc-air battery, demonstrating an open-circuit potential of 1.42 V and a peak power density of $\sim 45 \text{ mW cm}^{-2}$ - both are superior to those of its counterpart of the Pt/C air-electrode. The excellent multifunctional catalytic activities of the PANI/ZIF-67 are mainly attributed to the synergistic combination of cobalt nanoparticles, Co_3O_4 , and nitrogen doped carbon from the PANI/ZIF-67 complex after pyrolysis.

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