Three-dimensional Ni/Ni_3Fe embedded boron-doped carbon nanotubes Nano chain frameworks as highly efficient and durable electro catalyst for oxygen evolution reaction

Author links open overlay panel
Manigandan Ramadoss [a], Yuanfu Chen [a b], Yang Hu [a], Wenxin Li [a], Bin Wang [a], Xiaojuan Zhang [a], Xinqiang Wang [a], Bo Yu [a]

https://doi.org/10.1016/j.jpowsour.2020.227753 Get rights and content

Abstract

The electro catalytic water splitting is still seriously hindered by the sluggish reaction kinetics, large over potential, and high cost of oxygen evolution reaction (OER) electro catalyst. To address such issues, herein, for the first time, three-dimensional porous Ni/Ni3Fe anchored boron-doped carbon nanotubes nano chain frameworks (Ni/Ni3Fe/B-CNT), constructed by ultra-small Ni/Ni3Fe nanoparticles embedded in highly conductive B-doped CNT chains, are synthesized via a facile self-assembly hydrolysis method and corresponding growth mechanism is revealed. The low-cost Ni/Ni3Fe/B-CNT hybrid delivers excellent OER performance outperforming that of well-established benchmark electro catalysts (RuO2): it requires only 265 mV to obtain a large current density of 10 mA cm−2 (mass load ~ 0.28 mg cm−2); it shows a small Tafel slope of 62.9 mV dec−1 and excellent long-term stability even after 40 h. The outstanding OER performance of Ni/Ni3Fe/B-CNT is mainly attributed to its unique porous nano architecture with abundant active sites and the synergistic effect between the ultrathin Ni/Ni3Fe nanoparticles and highly conductive B-doped CNT skeleton; these merits facilitate the electron/ion transfer and oxygen bubble release thus significantly improve its OER activity. This work presents a well-designed nano architecture design and facile fabrication strategy to obtain nonprecious transition metal-based OER electro catalysts with excellent efficiency and long-term stability.