Vertical V-Doped CoP Nanowall Arrays as a Highly Efficient and Stable Electrocatalyst for the Hydrogen Evolution Reaction at all pH Values

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Abstract

Developing low-cost and high-efficiency electrocatalysts toward hydrogen evolution reaction (HER) in a wide pH range is still challenging. Herein, a three-dimensional (3D) porous nanoarchitecture, constructed by vertical V-doped CoP nanowall arrays (V-CPNA), has been grown on carbon cloth (CC) via a simple liquid-reaction approach and subsequent phosphorization. As a binder-free electrocatalyst, the V-CPNA/CC exhibits outstanding HER activity in the entire pH range. Particularly, it shows ultralow overpotentials of 87, 93, and 98 mV at 10 mA cm–2 in alkaline, acidic, and neutral media, respectively. Moreover, it delivers outstanding electrochemical durability with no degradation up to 60 h at all pH values. Such excellent electrocatalytic performance is mainly attributed to the synergistic effect between V and Co atoms. In addition, the unique 3D nanostructure of V-doped CoP nanowall arrays can promote the diffusions of H2 gas and the access of electrolytes, thus boosting the HER performance. This work presents a facile strategy to synthesize 3D porous heteroatom-doped metal phosphides as highly effective and stable pH-universal catalysts for HER.