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RGO-wrapped Ni-P hollow octahedrons as noble-metal-free catalysts to boost the hydrolysis of ammonia borane toward hydrogen generation

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ABSTRACT

Ni-P hollow octahedrons wrapped by reduced graphene oxide (Ni-P H-Oct-rGO) were prepared by phosphorization of the rGO wrapped NiS_2 solid octahedrons (NiS_2 S-Oct-rGO) precursor. The shell thickness of Ni-P hollow octahedrons was ~20 nm. As a catalyst for the hydrolysis of ammonia borane (AB), the Ni-P H-Oct-rGO exhibits the turnover frequency (TOF) and the activation energy (E_a) of 34.2 ± 0.6 mol_{H2} $mol_{Ni\text{-}P}^{-1}$ min^{-1} and 40.8 kJ mol^{-1} under ambient conditions, respectively. This work provides a simple synthetic method to obtain a high activity non-noble metal catalyst for the hydrolytic dehydrogenation of AB. The high surface area of Ni-P hollow octahedron with more active sites, the synergistic effect and interfacial interaction between Ni-P NPs and rGO, and the component and structural stability of Ni-P ensure that the Ni-P H-Oct-rGO present excellent activity and re-usability for the hydrolysis of AB. The as-prepared Ni-P H-Oct-rGO is an ideal candidate with superior catalytic performance and satisfied durable stability towards generating hydrogen, which is an important fuel in practical applications.

Keywords: Hollow octahedron, Reduced graphene oxide, Hydrogen, Ammonia borane

1. Introduction

Hydrogen, as the most promising carrier for clean and renewable energy, has attracted increasing attentions to solve environmental and energy issues[1-3]. But the low density of hydrogen makes it difficult to store and transfer in the liquid state, which limits its development[4, 5]. Various new materials have been developed to overcome these hurdles,

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