Nickel Phosphide as Hydrogen Evolution Reaction Electrocatalysts

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Hydrogen (H_2) is an attractive candidate for a clean and sustainable fuel. High-performance and low-cost hydrogen evolution reaction (HER) catalysts are critically needed for efficient H_2 production from water.[1] Noble metal catalysts, such as platinum, have high HER activity and durabilty[2], but they are too expensive. Developing inexpensive yet active HER catalysts made of earth-abundant elements remains a significant basic science challenge[3]. Pure nickel metal has been shown to be a feasible HER catalyst in alkaline media[4]. However, it's HER activity is limited in part because its hydrogen binding energy is too high[5]. By combining with an electron-negative element phosphorus, the nickel-hydrogen binding strength can be effectively weakened in nickel phosphides, possibly leading to improve HER activity[6]. In this work, nickel phosphide nanocrystals were synthesized by a wet chemical synthesis method. The size, shape and composition of the nickel phosphide nanocrystals were controlled by adjusting the reaction conditions. We found that nickel phosphide nanocrystals have much higher HER activity than their pure nickel metal counterpart,suggesting nickel phosphides are a very promising HER catalyst.

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