INTERNATIONAL JOURNAL OF HYDROGEN ENERGY 46 (2021) 21454–21461

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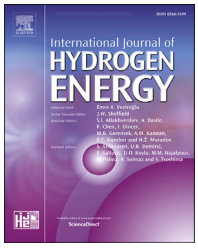

Encapsulation of Pt nanocatalyst with N-containing carbon layer for improving catalytic activity and stability in the hydrogen evolution reaction

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HIGHLIGHTS

- Pt@C core–shell catalyst was applied to hydrogen evolution reaction (HER).
- The catalyst was synthesized simply in one step annealing.
- The carbon shell containing N improved the activity and stability of the catalyst.
- The role of carbon shells in HER catalysis was investigated.

ARTICLE INFO

Article history:
Received 10 December 2020
Received in revised form
22 March 2021
Accepted 28 March 2021
Available online 24 April 2021

Keywords:
Pt
Catalyst
Hydrogen
Carbon layer
HER

ABSTRACT

As hydrogen emerges as a next-generation clean energy source, the production of hydrogen is generating much research interest. Water electrolysis, one of the promising methods of hydrogen production, has the advantage of no resource depletion or carbon dioxide emissions. In this study, a Pt@C core–shell catalyst in which an N-containing carbon layer covers individual Pt nanoparticles was applied to the hydrogen evolution reaction (the cathodic reaction of water electrolysis), and the effect of the carbon shell on the activity and stability of the catalyst was investigated. The catalyst was synthesized by simple annealing of Pt-aniline complexes at 600 °C in a N_2 atmosphere. The thermal decomposition of aniline during annealing resulted in N-containing carbon shells. The carbon shell had a positive effect on both the activity and stability of the catalyst in the hydrogen evolution reaction. Graphitic N and pyridinic N on the carbon shell, along with Pt, served as active sites for the hydrogen evolution reaction, increasing the catalytic activity. The carbon shell also effectively protected the Pt core from dissolution and agglomeration while allowing the transport of the reactant protons through the shell, improving stability with minimal loss of catalytic activity.

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https://doi.org/10.1016/j.ijhydene.2021.03.225