Facile Synthesis of 2D Platinum Nanosheets with Nanodendritic Structures for Efficient Hydrogen Evolution Reaction

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Introduction

The development of efficient and cost-effective electrocatalysts for the hydrogen evolution reaction (HER) is crucial for advancing clean energy technologies. While platinum (Pt) is an ideal catalyst for HER, its high cost and scarcity pose significant challenges for large-scale applications. Traditional synthesis methods for two-dimensional (2D) Pt nanomaterials are often complex and require special templates, making large-scale production both challenging and expensive [1]. This work reports a facile, one-pot, room-temperature approach for synthesizing 2D Pt nanosheets with nanodendritic structures.

Experimental Procedures

First, 20 mg of PVP, 0.05 mL of 100 mM cetyltrimethylammonium bromide (CTAB), and 1.5 mL of 5 mM K_2PtCl_4 were added to a mixed solvent of 4 mL of deionized water (DIW) and 0.5 mL of dimethylformamide (DMF). After the solution was well-dispersed, 0.5 mL of 100 mM ascorbic acid (AA) was introduced. The mixture was then heated in a water bath at 40°C for 3 hours. The resulting product was washed and collected by centrifugation.

Results and Discussion

SEM, TEM and AFM revealed the formation of Pt nanosheets with a nanodendritic morphology, exhibiting a lateral size of approximately 1 μm and a thickness of approximately 4 nm (Fig.1a, b). EDS, along with XPS and XRD, confirmed that the material is predominantly metallic platinum. In contrast to other reported methods that often require specialized surfactants [2], our approach utilized the commercially available CTAB. Characterization of the precursor material indicated that Pt and CTAB formed a layered crystal (Fig.1c). This layered precursor is believed to be the key to enabling the 2D growth mechanism. Electrochemical evaluation for the HER demonstrated that the nanodendritic structure offers a high electrochemical surface area and promising catalytic activity.

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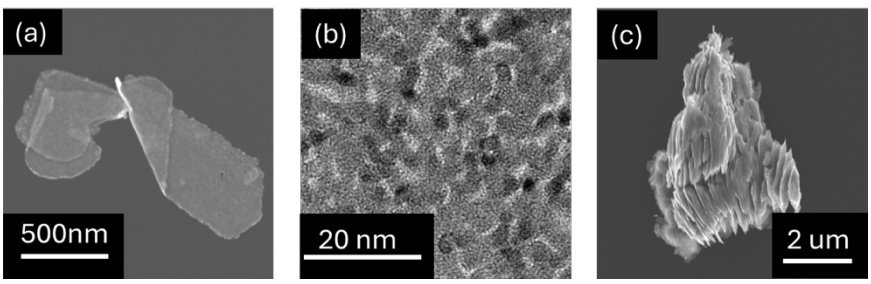

Figure 1. (a) SEM and (b) TEM images for Pt nanodendrite. (c) SEM image for layered crystal.

References

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