Controllable Preparation of a Three-Dimensional Porous Lead Dioxide Electrode with an Oxygen Bubble Template and Its Electrocatalytic Performance

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doi: 10.20964/2021.01.58

Received: 3 August 2020 / Accepted: 10 November 2020 / Published: 30 November 2020

Three-dimensional porous PbO₂ (3D-PbO₂) electrode was prepared by anodic oxidation deposition method, using an oxygen bubble template. To prepare 3D-PbO₂ electrode controllably, the influence of current density, Pb²⁺ ion concentration, and pH value on the structure and performance of PbO₂ electrode was studied. The results show that the current density determined the appearance of oxygen bubbles. The nucleation and growth of the oxygen bubbles were controlled by Pb²⁺ concentration and the pH value, respectively. The effect of the process conditions on the performance of electrode materials was obtained by comparing the electrocatalytic activities of the electrodes. The morphology and phase composition of the different anode materials were analyzed, and electrocatalytic activities were investigated by cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS). The CV curve shows that the total voltammetric charge (q_T^*) of the 3D-PbO₂ electrode was 70 times larger than that of the flat-PbO₂ electrode. In addition, during the evolution of oxygen, the 3D-PbO₂ electrode had a higher exchange current density (j^0), lower apparent activation energy (E_a) and lower charge transfer resistance (R_{ct}) than the flat-PbO₂ electrode.

Keywords: oxygen bubble template method; controllable preparation; lead dioxide; anode materials; electrocatalytic performance

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