

Obtaining Bi₂O₃ via electrochemical method for Solar to Hydrogen processes

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In recent years, Bi-based catalysts have been studied many times due to their low cost, environmental friendliness, high electrochemical activity and high electrocatalytic efficiency for water splitting [1-2]. Bismuth (III) oxide is a semiconductor with excellent physical properties, especially optical and electrical properties, such as a wide energy gap, contributing to the very good photocatalytic properties, high refractive index and permittivity, very good photoconductivity and luminescence properties [6]. Bismuth oxide has six crystallographic structures, designated as α -Bi₂O₃ (monoclinic) [7], β -Bi₂O₃ (tetragonal) [8], δ -Bi₂O₃ (face-centered cubic) [9], γ -Bi₂O₃ (body-centered cubic) [10], ε -Bi₂O₃ (orthorhombic) [11], and φ -Bi₂O₃ (triclinic), respectively [12]. Bismuth-based mixed oxides exhibit predominantly n-type semiconductivity and therefore function as photoanodes in photoelectrochemical water splitting process. They exhibit low catalytic activity for oxygen evolution, resulting in hole accumulation at the electrode/electrolyte interface.

The aim of this work is to create corrosion-resistant semiconductor electrode materials that are sensitive to the visible region of the solar spectrum.

To obtain Bi₂O₃, metallic Bi was deposited on nickel electrodes by an electrochemical method. In this case, Bi(NO₃)₃ was used as a precursor and dissolved in ethylene glycol. The polarization curve of the process electroreduction bismuth ions shown Fig. 1.

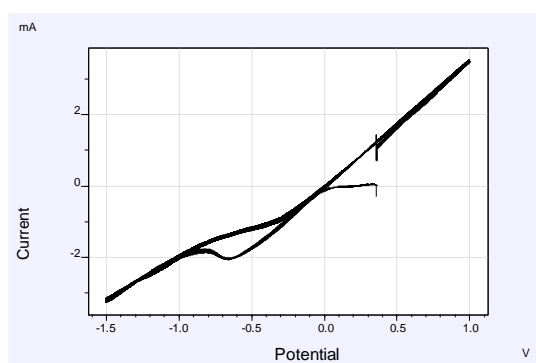


Fig.1. The polarization curve of the process electroreduction bismuth ions.

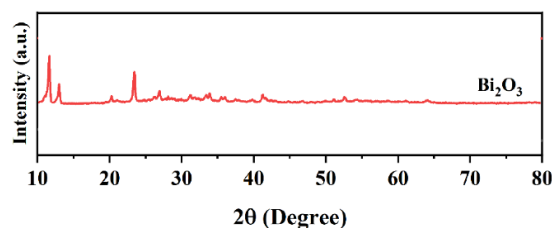
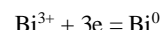


Fig. 2. Results of X-ray phase analysis for Bi₂O₃ obtaining via electrochemical method.

The electroreduction of bismuth ions occurs the potential range -0.25 - (-0.65) V. Starting from -0.25 V, to -0.65 V occurs electroreduction bismuth ions with this reaction:



Further, with of the electrode surface passivation (here the electrode surface is completely covered with an bismuth film), the current spent on the process is stabilized. Starting from -0.85 V, with an increase in potential, there is also an increase in current.

After electrodeposition Bi thin films on the Ni electrode, they had been annealed at the 850°C for obtaining Bi₂O₃. Getting of Bi₂O₃ had been confirmed with X-ray analysis.

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