Insights into the BaTiO$_3$-Pb Perovskite Semiconducting Layer in PbO$_2$ Electrode Preparation by Electrochemical Deposition and Its Performance Evaluation

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PbO$_2$ electrode has high water splitting potential as that of BDD electrode, but no stability was shown in electrochemically deposited PbO$_2$ electrode. In this work, the effect of lower layer (a perovskite type dielectric BaTiO$_3$) on PbO$_2$ electrodeposition and its electrochemical performance evaluation was enrooted. BaTiO$_3$ was deposited on pretreated Ti in highly basic 4 M KOH medium resulted in needle shaped BaTiO$_3$ crystals of length 4.79 µm and width 0.43 µm. Co-deposition with nano-PbO$_2$ (BaTiO$_3$-NPb) and Pb(NO$_3$)$_2$ (BaTiO$_3$-Pb) produced a flower- and fur tree-like structures, respectively. Further, the upper layer of PbO$_2$ deposited in acid medium on BaTiO$_3$-NPb and BaTiO$_3$-Pb completely changed the shape to cauliflower-like shapes and cauliflower-like shapes with rock-like shapes, respectively. XRD result demonstrated the BaTiO$_3$ structure orientation was influenced to achieve mostly β-PbO$_2$ orientation. Electrochemical impedance and cyclic voltammetry analyses of BaTiO$_3$-NPb/PbO$_2$ and BaTiO$_3$-Pb/PbO$_2$ electrodes demonstrated smooth and porous morphological surfaces, respectively. When BaTiO$_3$-NPb/PbO$_2$ electrode was applied as an anode for the direct oxidation of phenol, it was found a considerable impact on its catalytic activity. An accelerated stability test result demonstrated BaTiO$_3$-NPb/PbO$_2$ is stable for more than 3000 h in H$_2$SO$_4$ medium.

**Keywords:** BaTiO$_3$, Morphological Change, Co-deposition, PbO$_2$.

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