

Surface modification of BiVO₄- based Photoanodes for Water Oxidation

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Photoelectrochemical (PEC) water oxidation is an important approach to utilize solar energy for producing chemical fuels. Surface modification of photoanodes with oxygen evolution reaction (OER) catalysts is an effective method to enhance kinetics of water oxidation and improve the efficiency of energy harvesting in PEC water oxidation. BiVO₄ is a promising anode material for this purpose. Various catalysts such as iron-nickel oxide and cobalt oxide have been used for improving water oxidation efficiency in BiVO₄ photoanodes. However, the efficiency achieved with this material is still far away from what is expected. ^[1,2,3] Improving photoelectrochemical activity of BiVO₄ together with stability in long term utilization is another challenging issue in this field. In present work, we prepared undoped and Mo-doped BiVO₄ photoanodes and modified the surface by deposition of TiO₂ as protective layer and CoO_x film as catalyst. Deposition of ultrathin films was done by atomic layer deposition (ALD). TiO₂ was also deposited under BiVO₄ as a hole blocking layer. Utilizing ALD enabled us to control the thickness of the films in nanometer level. Surface of BiVO₄ was modified by O₂ plasma treatment before and after deposition of CoO_x layer and the local geometry of CoO_x layer was investigated by Co L-edge X-ray absorption spectroscopy. Besides, the structure of the films and surface species were studied by grazing incident X-ray diffractometer and X-ray photoelectron spectroscopy, respectively. We showed that modification of BiVO₄ surface results in higher coverage of surface with CoO_x catalyst layer. Treatment of photoanodes after CoO_x deposition leads to enhancement in photoelectrochemical activity of the anode. It is also shown that the amorphous TiO₂ layer on BiVO₄ protects it against photocorrosion in long term experiments. Fig.1 shows the schematic illustration of prepared photoanodes.

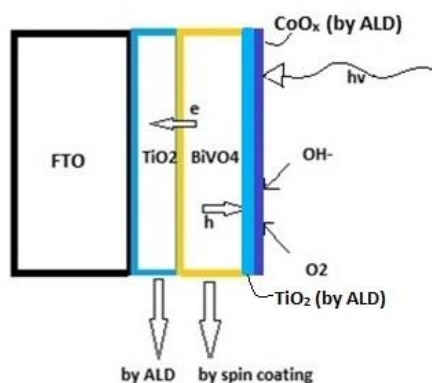


Figure 1. Schematic representation of BiVO₄- based photoanodes

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