SYNTHESIS OF NANOSTRUCTURED ANODIC TiO_2 IMPREGNATED WITH CO, CU, FE IONS FOR PHOTOELECTROCHEMICAL APPLICATIONS

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For many years, titanium oxide(IV) has been the subject of research conducted in many scientific institutions around the world. Recent studies have mainly focused on anodic TiO_2 due to its fascinating properties, such as good chemical stability, biocompatibility, and non-toxicity [1]. For this reason, anodic titanium oxide layers had been successfully used for photoelectrochemical water splitting, in photocatalysis and even medicine [2,3]. However, from the practical point of view, photoelectrochemical applications are limited by a relatively high energy gap (3.2 eV), which means that only the ultraviolet light can be absorbed by this material (λ <400 nm) [4]. To solve this problem, and broaden the range of radiation, many different modifications of this semiconductor are used, of which in-situ doping, electrochemical deposition, and impregnation in solutions containing transition metal ions are of special interest [5].

In this study, in order to obtain nanoporous titanium oxide layers, three-step anodization in ethylene glycol based electrolyte containing 0.38% wt. NH_4F and 1.79% wt. H_2O at a constant potential of 40 V was used.

The modification method was based on the impregnation of anodic TiO_2 samples with solutions containing various concentrations (25 – 100 mM) of cobalt, copper, and iron ions followed by their annealing at 400 °C. The morphology and chemical composition of synthesized materials were investigated by using a field emission scanning electron microscope (FE-SEM/EDS), and their structure was determined by X-ray diffraction

(XRD). The photoelectrochemical properties were characterized by UV-Vis spectroscopy.

The data showed that the structure of anodic TiO_2 samples impregnated with cobalt, copper, and iron ions was changed depending on the concentration of transition metal ion used. Anodic TiO_2 samples showed maximum absorption at 350 nm and it changed depending on the modification ion used. The modified TiO_2 samples exhibited different photoelectrochemical properties from those observed for unmodified TiO_2 samples. In conclusion, obtained material can be a promising nanomaterial with improved photoelectrochemical performance.

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References

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