COBALT DOPED NANOTUBULAR TITANIUM OXIDE

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This paper presents a study Co-doped nanotubular titanium oxide (Co-NTO) obtained by anodizing at 30 V 40 min. Cobalt doping of NTO was carried out by immersion in a solution of 0.1 M cobalt nitrate for various times, followed by annealing in air.

Because of declining stocks of existing and growing demand for promising fuel sources, there is an increasing need to create and use renewable fuel sources, including hydrogen. Its production is a very energy-intensive technology in traditional water electrolysis, so hydrogen production technology using renewable resources such as solar energy and water is required. This technology is founded by using the process of photocatalytic decomposition of water. This direction is becoming more popular over the years, which motivates scientists to look for new solutions to improve the properties of existing materials. It is titanium oxide has several interesting significant characteristics: non-toxicity, photodegradation resistance, small bandgap, sufficient photoconversion, and photocatalytic efficiency. To improve these characteristics, researchers widely use cationic and anionic doping and surface decoration methods. Papers about cationic doping [1,2] show an increase in the photoconversion efficiency in photocatalytic water splitting and a decrease in the bandgap. These papers present the development perspective of titania and the material ability to work in the visible spectrum and better photocatalytic efficiency.

It is believed that doping with cobalt can significantly increase photoconversion efficiency, a shift in the conversion peak from the UV to the visible part of the spectrum [3], and an improvement in the photodegradation of pollutants. Doping of TiO_2 is carried out by various methods: hydrothermal, electrodeposition of particles on the surface and immersion method. The preparation of nanotubular coatings of titanium oxide (nt-ATO) in an organic electrolyte with fluoride-containing ions was considered in the paper [4]. The results showed a decreasing bandgap from 3.4 to 3.2 eV, the maximum IPCE was increased from 5.8 to 8.3%, and the conversion peak shift was approximately 30 nm.

The titanium substrate was electrochemical polished in a solution containing 80 ml of ethylene glycol (EG), 20 ml of isopropanol, and 1 M NaCl at a direct current of 20 V for 50 min. Nt-ATO coatings on a polished titanium substrate were obtained in an electrolyte containing EG, ammonium fluoride 1.5% mol and water 2.3% mol at a voltage of 30 V with an anodizing time of 40 min. Then, the amorphous nt-ATO samples were immersed in a 0.1 M $Co(NO_3)_2$ solution and kept in it from 1 to 12 h. Then they were treated at a temperature of 400°C for 1 hour, with a heat-cooling rate of 1°C/min, in an air atmosphere.

The obtained samples were examined using a scanning electron microscope (SEM), XRD and incident photon-to-electron converse spectrometry methods. Figure 1 shows the SEM image of obtained Co-ntTO.

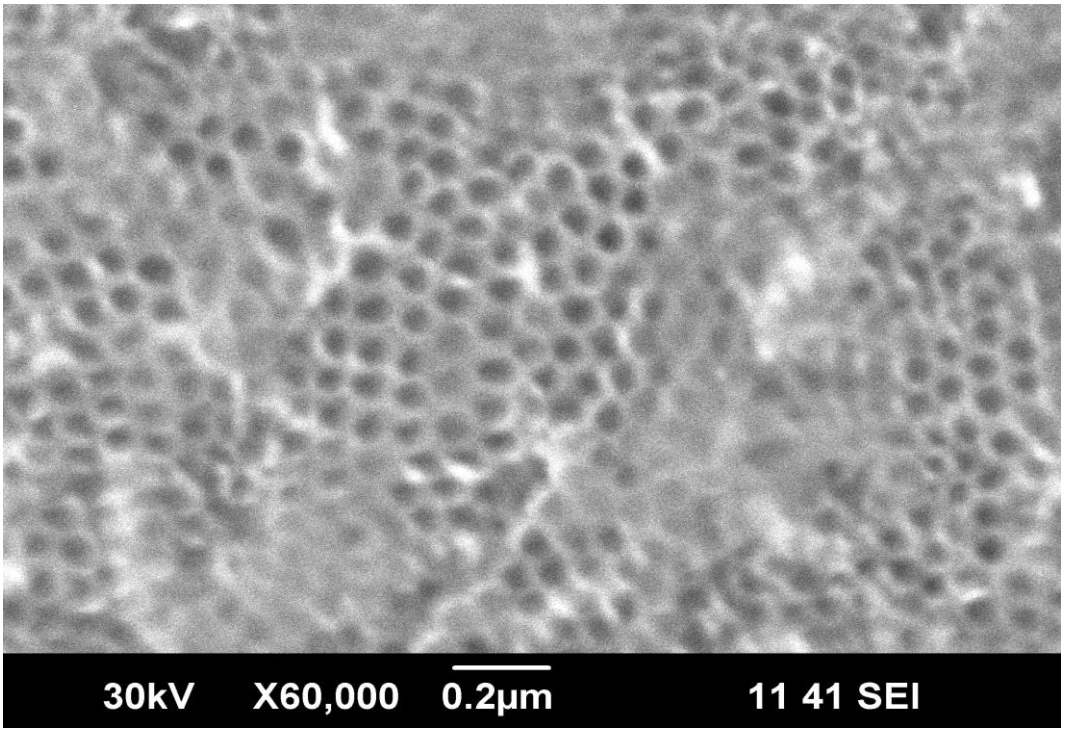

Fig. 1. SEM-image of surface Co-ntTO sample

Studying the efficiency of IPCE samples depending on the time of doping by immersion in a solution will show which samples have the best efficiency and the formation of impurity levels at which conversion occurs.

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