Investigation of the Effect of Surface Pretreatment Parameters and Concentration of Electrolyte Composition on the Quality of Tio_2 Nanotubes used as the Photoanode of the Dye-Sensitized Solar Cell

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TiO_2 nanotubes have been widely used for enhancing the power conversion efficiency of dye-sensitized solar cells (DSSC) due to their high electron transport properties. The nanotubes provide direct electron transfer pathways leading to excellent electron transport. An increase in the specific surface area of nanotubes will increase the adsorption of dye molecules, which will positively affect the power conversion efficiency of DSSC. In this work, the influence of surface pre-treatment parameters and concentration of electrolyte composition on the geometric parameters of TiO_2 nanotubes were studied.

TiO_2 nanotubes were obtained by electrochemical anodizing of Ti substrate. Anodizing parameters: U = 30 V, I = 400-800 mA, τ = 1 hour. Preliminarily the surface of the Ti substrate was subjected to successive treatment with acetone, ethyl alcohol, 3% hydrogen peroxide solution, and inorganic acids, namely HCl, HF. An aqueous solution containing 0.5-1 M H_3PO_4, 0.14-0.28 M NaF was used as the electrolyte.

Additional surface pre-treatment of the Ti substrate by acids led to generation more smooth surface, which facilitated the formation of a structured array of the nanotubes. An increase in the concentration of fluoride ions in the anodizing electrolyte led to a decrease of the internal diameter of nanotubes from 150 to 71 nm. Whereas the increase in the concentration of orthophosphoric acid had an insignificant effect on the geometric parameters of nanotubes. However, at the concentration of 1 M H_3PO_4 in the electrolyte the appearance of empty spaces between the nanotubes was established.

Thus, the obtained TiO_2 nanotube samples were used as photoanode in the DSSC with N719 dye, iodide-triiodide redox electrolyte and spattered platinum on ITOPEN substrate as counter electrode. Produced cell showed satisfactory photocurrents at the level of literary data.