

Preparation of Thick Titanium Dioxide Films by Repeated Electrolysis-Calcination for Dye-Sensitized Solar Cells

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Abstract

Titanium dioxide (TiO_2) films were prepared by cathodic galvanostatic electrolysis of a solution of titanium bis(ammonium lactato)dihydroxide (TALH) and ammonium nitrate (NH_4NO_3) at 323 K on a transparent conducting substrate (fluorine-doped tin oxide; FTO) and calcination at 723 K. The effect of NH_4NO_3 concentration on the deposition rate and quality of films was investigated. An active electrodeposition of the films was observed after the calcination of previously electrodeposited layers. A mechanism for the film growth at widened crack spaces within the deposits by calcination was proposed. The TiO_2 films were thickened beyond 5 μm by four repeated electrolysis–calcination cycles. The energy conversion efficiency of a dye-sensitized solar cell fabricated using TiO_2 films could be optimized to 5.15% by controlling the electrolysis current.