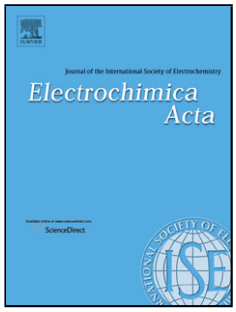

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Synthesis, electrochemical impedance spectroscopy study and photoelectrochemical behaviour of as-deposited and annealed WO_3 films

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Abstract

WO_3 films have been obtained by anodization of tungsten in the different acidic electrolytes (HCl, H_2SO_4, H_3PO_4, H_3PO_4 + NH_4F) and at various applied potentials. Electrochemical impedance spectroscopy was used to investigate film formation and to characterize the obtained oxide films. The equivalent electric circuits modelling reactive and blocking behaviour are provided and discussed. It was found, that oxide film capacitance decreases linearly with increasing anodization potential. The relative permittivity of tungsten oxide films varies from 31 to 56 depending on the acid used. A relatively high rate of the film formation (1.87 nm V^{-1}) and increased resistance against oxide breakdown can be achieved for tungsten oxide obtained from 0.3 M oxalic acid bath. Compact oxide films are formed at the potentials ranged from 10 V to 30 V, whereas increasing of anodization voltage to 60 V resulted in the formation of disordered, porous structures due to surface etching. Semiconductor properties were determined by Mott-Schottky analysis. Photoelectrochemical properties of as-deposited and annealed at 600°C WO_3 films were determined in a Na_2SO_4 solution under pulsed and constant UV irradiation. It was determined that annealed WO_3 films in comparison to as-deposited films are more stable and generate substantially higher photelectrochemical currents.

Keywords: anodization, tungsten trioxide, electrochemical impedance spectroscopy, annealing, photocurrent.