Fabrication and Characterization of Ag-TiO$_2$-NTs and Investigated Carrier Density in I$^-$/I$_3^-$ Electrolyte by Electrochemical Impedance Spectroscopy

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[keywords] Ag-TiO$_2$-NTs, Electrodeposition, EIS analysis, Carrier density.

TiO$_2$ has been regarded as promising semiconductor material, due to its large surface area, high porosity, good electrical transport, low charge carrier recombination loses and excellent structural durability [1]. In this study, TiO$_2$-NTs electrode was successfully fabricated by two-step anodization technique. Then, the potentiostatic deposition was performed at -0.3 V and various deposition times (240, 600 and 1800 s) in 0.75 mM AgNO$_3$ solution containing 10 mM KNO$_3$ supporting electrolyte. The morphology, composition and structure of Ag doped TiO$_2$-NTs were determined by field emission scanning electron microscopy (FE-SEM), energy dispersive X-ray spectroscopy (EDX) and X-ray diffraction (XRD). The results showed that as deposition time increases, Ag NPs size continued growing and based on the XRD results, after deposition of Ag, the crystalite size of anatase TiO$_2$ decreased from 22.43 nm to 14.62 nm and increased with increasing of deposition time (from 240 s to 600 s and 1800 s) from 14.62 nm to 18.38 nm and 17.33 nm, respectively. The electrochemical behaviors of Ag doped TiO$_2$-NTs in acetonitrile electrolyte contained I$^-$/I$_3^-$ were examined by utilizing Electrochemical Impedance Spectroscopy (EIS). The Mott-Schottky analysis revealed that the charge transport in Ag doped TiO$_2$ electrode, (having the highest charge carrier density ($3.96 \times 10^{10}$cm$^{-3}$)) obtained after 600 s of deposition time is realized faster.

![Figure 1. FE-SEM images and XRD patterns of Ag doped TiO$_2$-NTs electrodes obtained at constant potential of -0.3 V at different time.](image)

Nyquist plots (e) recorded at -0.4V for Ag doped TiO$_2$-NTs electrodes in acetonitrile electrolyte contained I$^-$/I$_3^-$ after 1h of electrode immersion.

* This work was financially supported by Cukurova University Scientific Research Unit (Project No: FEF2013D29) and the authors thank for financial support of the Scientific and Technological Research Council of Turkey (TÜBİTAK 2211-C program).

References