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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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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 -0.3V 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 crystallite 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 ($3.96.10^{19}cm^{-3}$)) obtained after 600 s of deposition time is realized faster.

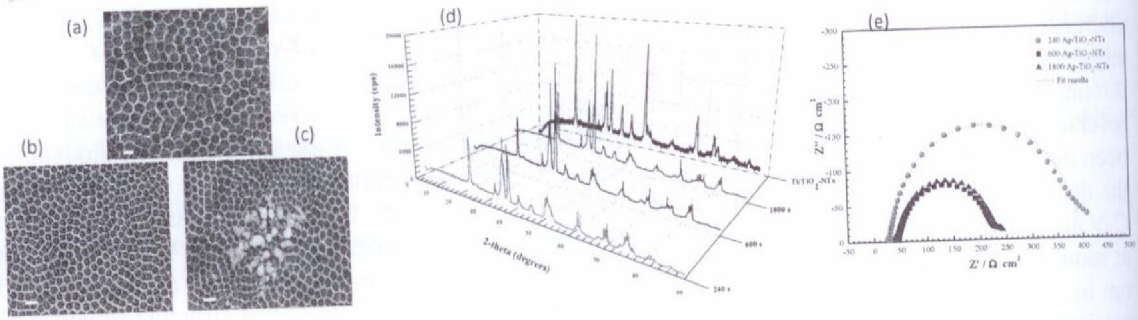


Figure 1. FE-SEM images and XRD patterns of Ag doped TiO_2-NTs electrodes obtained at constant potential of -0.3 V at different time ((a) 240, (b) 600, (c) 1800 s). Nyquist plots (e) recorded at -0.4V for Ag doped TiO_2-NTs electrodes in acetonitrile electrolyte contained I^-/I_3^- after 1h of electrode immersion.

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References

[1] M. Yang, et al., Electrochim. Acta **125**, 288 (2014).