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SYNTHESIS OF HIGHLY POROUS PHOTOACTIVE WO_3 FOR GENERATION OF ClO^-

M. Parvin, **M. Petrulevičienė, I. Savickaja, V. Pakštas, A. Naujokaitis, R. Ramanauskas, J. Juodkazytė**

Center for Physical Sciences and Technology, Saulėtekio av. 3, Vilnius 10257, Lithuania

maliha.parvin@ftmc.lt

INTRODUCTION

Photoelectrochemical (PEC) generation of reactive chlorine species has attracted considerable attention because synthesis of H_2 on cathode can be coupled with production of high added-value chemicals such as HClO, H_2O_2, etc. on suitable photoanode [1]. Chloride anion oxidation (or hypochlorite production) is an attractive alternative to the oxygen evolution reaction due to a large amount of seawater as natural electrolyte on Earth and the massive application of hypochlorites in industrial water disinfection and sanitization [2-3]. In this study, porous WO_3 films were formed on fluorine-doped tin oxide (FTO) substrates by low temperature chemical bath deposition (CBD) and tested for PEC chloride oxidation.

WO_3 COATING PREPARATION

To prepare WO_3 photoanode, $Na_2WO_4.2H_2O$ was dissolved in deionized water under constant stirring, which was followed by the addition of citric acid and 3 M HCl consecutively. Cleaned FTO substrates were immersed in the above solution and the deposition was allowed to proceed for two hours. The films were annealed at 400 ^oC. The same procedure was repeated four times to obtain layers with increasing thickness.

COATING CHARATERIZATION

The coatings were characterized using scanning electron microscopy (SEM) and X-ray diffraction (XRD) analysis.

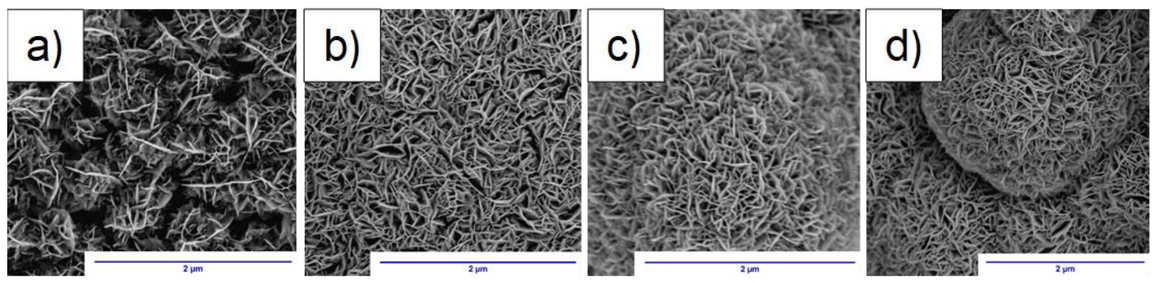

Fig. 1. Top-view SEM images of a) 1-layer, b) 2-layered, c) 3-layered, d) 4-layered WO_3 coatings..

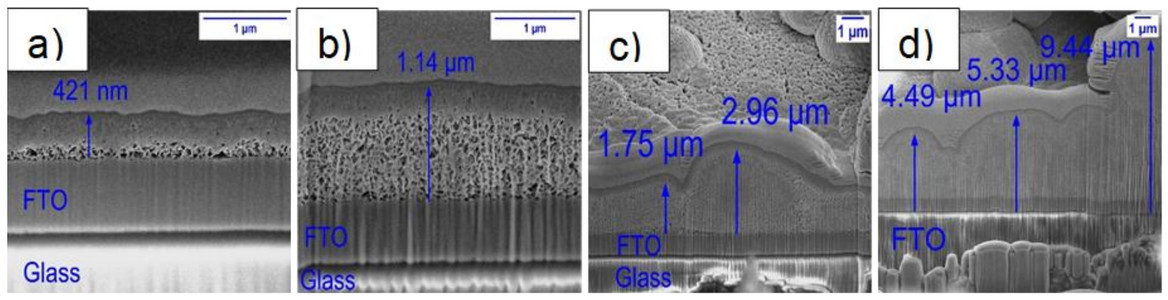

Fig. 2. SEM cross-section images of a) 1-layer, b) 2-layered, c) 3-layered and d) 4-layered WO_3 coatings.

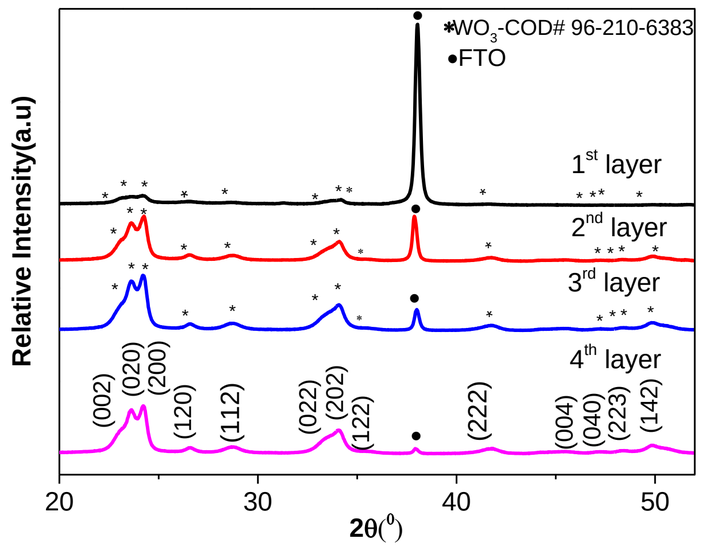

Fig.**3.** XRD patterns of WO_3 coatings of different thickness.

PHOTOELECTROCHEMICAL RESULTS

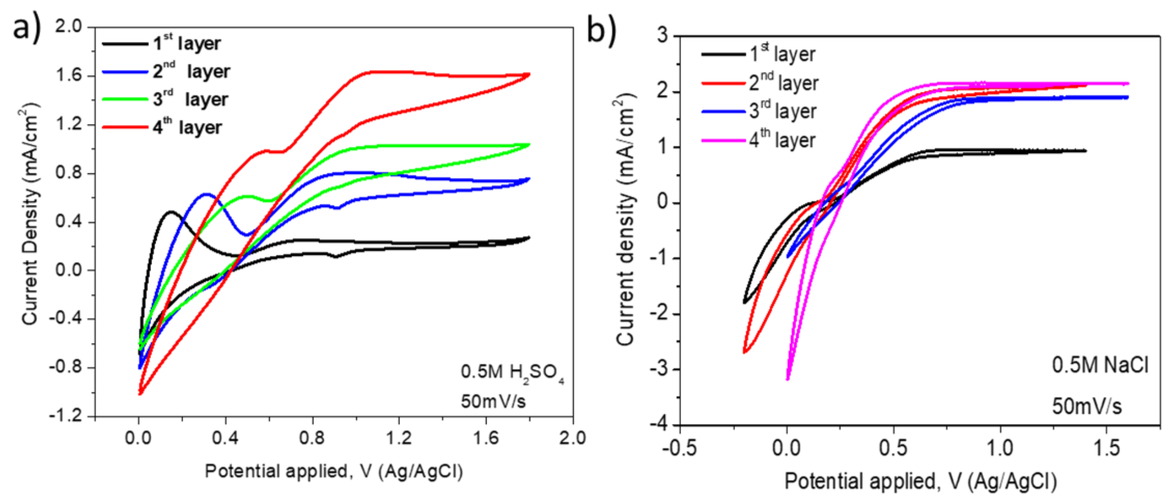

Fig. **4**.a) Cyclic voltammograms of 1-, 2-, 3- ,and 4-layered WO_3 coatings in a) 0.5 M H_2SO_4 and b) 0.5 M NaCl, potential scan rate 50 mV s^{-1} , illumination intensity (~ 100 mW cm^{-2}).

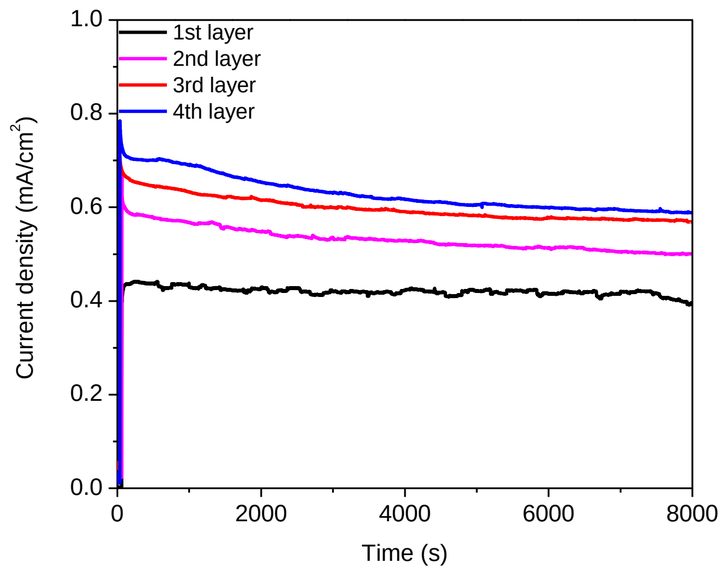

Fig.**5**. Stability test of 1-, 2-, 3- ,and 4-layered WO_3 coatings at 1.4 V (vs. Ag/AgCl) in 0.5 M NaCl, illumination intensity 100 mW cm^{-2}

CONCLUSIONS

- WO_3 coatings of increasing thickness (0.4 – 10 µm) and nanosheet morphology were successfully formed on conducting glass substrate using facile chemical bath deposition synthesis. (Fig. 1, 2).
- Crystallinity of prepared monoclinic WO_3 films increased with increasing thickness of the coatings (Fig.3).
- The photocurrents of CBD-deposited WO_3 films were found to be increasing with the layer thickness in 0.5 M H_2SO_4 (Fig.4.a) and 0.5 M NaCl (Fig.4.b).
- All coatings were stable under photoelectrolysis conditions in 0.5 M NaCl for at least 2 h.
- Faradaic efficiency of PEC formation of ClO^- was about 16.09% , 19.75%, 20.5% and 25.19% for 1-, 2-, 3- and 4-layered WO_3 coatings, respectively.

ACKNOWLEDGEMENT

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