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Electrochemical synthesis of nanostructured Zirconia functionalized with β-cyclodextrin.

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Abstract – Zirconia nanostructures were synthesized on FTO electrode surface in aqueous medium by cyclic voltammetry using carboxymethyl-β-cyclodextrin (cm-β-CD) like functionalizer. The voltammograms shows differences during the electro-deposition of ZrO_2 with cm-β-CD compared to ZrO_2 without cm-β-CD. Besides, AFM images shows better morphology definition of ZrO_2/ cm-β-CD system compared to ZrO_2. In short, well defined nanostructures of ZrO_2 functionalized with cm- β-CD were obtained like a promising system to the sensing of aromatic organophosphate compounds at aqueous medium.

Zirconia (ZrO_2) is an inorganic oxide with excellent thermal and chemical stabilities that have been used like a specific sensor material to organophosphate compounds detection [1-2]. In this work we synthesized Zirconia nanostructures with carboxymethyl-β-cyclodextrin (cm-β-CD) like functionalizer. These nanostructures were synthesized on FTO electrode surface by cyclic voltammetry of precursors at aqueous medium. The solution used was composed of NaCl 0.1 M (supporting electrolyte), $ZrOCl_2$ 0.01 M and cm-β-CD 0.1% (w/w). The deposition was achieved by cycling the potential between -1.2 and 0.00 V (vs. Ag/AgCl) at a scan rate of 10 mV/s for 10 consecutive cycles. Two samples were synthesized for comparison: ZrO_2 with cm-β-CD and ZrO_2 without cm-β-CD.

The voltammograms shows a gradual increase of oxidation current during the cycles of ZrO_2 deposition without cm-β-CD. In the case of ZrO_2 with cm-β-CD the increase of oxidation current was quenched at the fifth cycle of deposition that we correlated with coordination between ZrO_2 surface and carboxyl group of cm-β-CD.

The AFM analysis (Figures 1, 2 and 3) shows the surface topography of FTO electrode, ZrO_2 and ZrO_2 / cm-β-CD, respectively. The nanostructures of ZrO_2 without cm-β-CD were formed in large numbers compared to sample with cm-β-CD. Besides, the morphology of ZrO_2 / cm-β-CD nanostructures were better defined. This effect is probably due to the ZrO_2 surface functionalization by cm-β-CD that controls the deposition process of oxide on the substrate.

In conclusion, we obtained a morphological well defined nanostructures of ZrO_2 functionalized with cm- β-CD that is a promising system to the sensing of aromatic organophosphate compounds at aqueous medium.

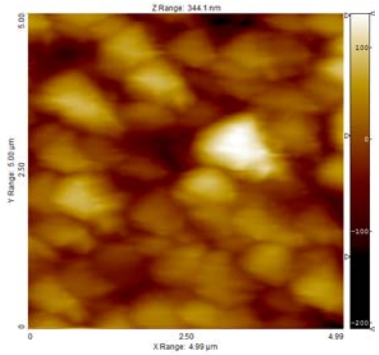

Figure 1: AFM image of FTO electrode surface.

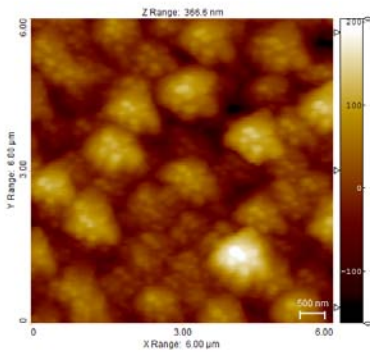

Figure 2: AFM image of ZrO_2 nanostructures without cm-β-CD.

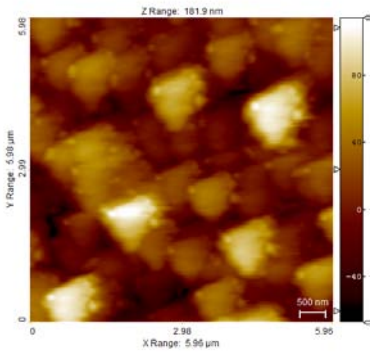

Figure 3: AFM image of ZrO_2 nanostructures with cm-β-CD.

References

[1] G. Liu and Y. Lin. Anal. Chem. 77 (2005) 5894.
[2] M. Wang, Z. Li and Y. Gao. Sensor Lett. 6 (2008) 966.