Deposition of gold nanoparticles on titanium nanopits

Marek P. Kobylański, Zuzanna Juchno, Mateusz A. Baluk, Adriana Zaleska-Medynska

Department of Environmental Technology, Faculty of Chemistry, University of Gdansk, Wita Stwosza 63, Gdansk, Poland

Corresponding author: marek.kobylanski@phdstud.ug.edu.pl

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Introduction

A necessity to obtain a new matrix for metal nanoparticles or quantum dots require to develop materials, which dimension could be easily controlled. The TiO₂ nanotubes obtained via anodic oxidation of a titanium foil could be easily produced and their synthesis conditions as electrolyte composition, applied voltage, time of anodization directly influence on their dimension (Kobylański et al., 2018). Utilizing the surface of titanium created after removing of the NTs allow to obtain pits, which could be a space for deposited nanoparticles. Subsequently, it is possible to deposit the gold nanoparticles from their precursor by photodeposition or spin-coating method and finally, obtain the titanium matrix with the nanoparticles. The shape of gold nanoparticles depends on the experiment condition, but it is possible to obtain the triangle structures of gold (Carville, Neumayer, Manzo, Gallo, & Rodriguez, 2016; Ng, Razak, Aziz, & Cheong, 2014).

Materials and Methods

The procedure of fabrication of nanopits include synthesis of TiO₂ nanotubes via anodic oxidation, removing of the TiO₂ nanotube arrays in ultrasonic bath, subsequent anodization and dissolution of nanotubes in oxalic acid. Finally, the nanoparticles of gold was deposited on the surface of titanium by photodeposition of gold nanoparticles from the precursor - 0.05 M of chloride gold (III) solution in isopropanol. The light source was a 250 W Xenon lamp under. The nanoparticles deposited using spin-coater was obtained from the same solution. The solution in the range of 100-500 µl was dropped on the center of titanium foil, subsequently the layer was coated with rotational speed 1500 rpm. Then, samples was dried at 80 °C and calcined for 10 min in 450 °C.

Results

Figure 1 shows the SEM images of gold nanoparticles deposited on titanium pits. It could be concluded that samples obtained from photodeposition (Figure 1a) characterized irregular shape and size in contrast to utilize spin-coater (Figure 1b).

Figure 1. SEM images of gold nanoparticles deposited on the titanium surface by: a) photodeposition, b) spin-coating method.

Discussion

Based on the comparison of the SEM images it could be concluded that nanoparticles obtained by spin-coating method allow to obtain the nanoparticles which size is more regular than for materials fabricated via photodeposition method. Moreover, by utilizing spin-coating method it is possible to obtain triangle nanostructured of gold. The size of the gold nanoparticles is in the range 5 – 20 nm, however, the nanoparticles is loaded inside the pits as well as on their walls. Based on the all obtained results it could be concluded, that pits fabricated from dissolution of TiO₂ nanotubes could be a good matrix for deposition of gold nanoparticles. These kind of materials could be applied in the sensor for chemical substances.

Acknowledgments

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