11th International Conference on Advanced Materials
Rio de Janeiro Brazil
September 20 - 25
ICAM2009

Transducers based on gold nanowires arrays.

C. Vera-Oyarce[(1)*], E. Vargas[(2)], C. P. Silva[(2)], J. Pavez[(1)], M. Páez[(1)].

(1) Universidad de Santiago de Chile, e-mail: cristianveraoyarce@gmail.com.
(2) Departamento de Química de los Materiales, Santiago, Chile, Av. Libertador Bernardo OHiggins 3363, Estación Central. * Corresponding author.

Abstract – Gold nanowires arrays have been synthesized by electrodeposition method using porous anodic alumina (PAA) of different diameter as template. The PAA have been synthesized in two-step anodizing process on specific conditions and long anodizing time. The template showed hexagonal porous arrays with diameter approximately of 30 – 100 nm depending of the using electrolyte (H_2SO_4, $H_2C_2O_4$) in anodizing process (Fig. 1). Atomic Force Microscopy (AFM) and Scanning Tunneling microscopy (STM) was used for the initial characterization of template and gold nanowires arrays.

Within the experimental strategies for the fabrication of nanostructures, materials with ordered pores with dimensions ranging from the submicrometer to nanometer, have generated considerable interest, because offers a very good template for quality fabrication of nanodevices. Porous anodic alumina (PAA) is one of the templates more largely used, which is formed by the anodization of Al, it is a typical self-ordered nanoporous material with a large ordering and density (10^{12} porous/cm^2). With these features this material becomes a perfect template to obtain nanoarray structures. The electrodeposition is one of the most commonly used methods, among other ones, for filling of nanochannels of alumina films, forming continuous and highly conductivity nanowires, being the porosity of anodic fillms (diameter and deepness of the pores) an important issue to consider.

In this work we show the state of on going investigation about the fabrication of an electrochemical transducer (for an electrochemical sensor) based on functionalized gold nanowires obtained by electrodeposition onto PAA template. The PAA has been synthesized by two step anodizing [1] process using high purity (99,999%) Al foils acid electrolyte (H_2SO_4, $H_2C_2O_4$), low temperature and long anodizing times. Al foils were first cleaned in acetone and them electropulished. Anodazation was performed potentiostatically in 0,3 M oxalic acid at 40 V, 60 V and in 0,3 M sulphuric acid at 25 V. After the first anodization, the oxide film with a low pore ordering was removed in phosphoric acid/ chromic acid mixture at room temperature. After the second anodization step we obtained a highly ordered porous alumina film (Fig 1). Porous anodic alumina template were obtained by dissolving the non oxidized Al in copper chloride solution and afterwards the barrier layer was dissolved in phosphoric acid solution at 25℃ for a few minutes.

Before electrodeposition, an Au film was coated onto bottom side of the PAA to make the conductive template. The PAA Au-coated membrane, was used as working electrode for electrodeposition of gold nanowires . The electrodeposition were performed using chronoamperometry at constant potential. Once the electrodeposition was finished, the template was dissolved in NaOH solution, obtaining the final gold nanowires arrays. The templates were characterized by AFM. The figure 1 show a top view of template prepared in oxalic at 40 V, showing the typical hexagonal arrangement, with diameters of about 65 nm, which is in agreement with those reported in other studies [2]. The template prepared in oxalic acid 0,3 M at 60 V and sulphuric acid 0,3 M at 25 V, showed pore diameter of about 110 nm and 30nm respectively.

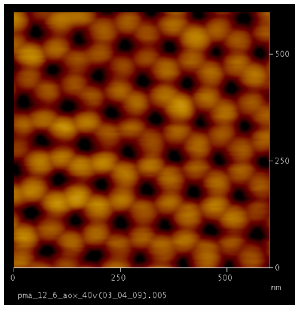

Figure 1: AFM top view image of the alumina template prepared in oxalic acid 0,3 M at 40V.

References

[1] H. Masuda, K. Fukuda, Science, 268, (1995), 1466.
[2] K. Biswas, Y. Qin, M. DaSilva, R. Reifenberger, and T. Sands, Phys. Stat. Sol, 204, (2007), 3152.
[3] G. Kartopu, S. Habouti, M. Es-Souni, Material Chemistry and Physics, 107, (2008), 226.
[4] I. Mu, W. Shi, J. C. Chang, and Shuit-Tong Lee, Nano Letters, 8, (2008),104.