Electrochemical Perforation of the Aluminum Oxide Barrier Layer in Thin Film Micro Sensors

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Nanoporous anodic aluminum oxide (AAO) has been used as a template for growth of various functional nanomaterials and as a scaffold for nanodevices and systems [1]. Porous AAO membranes have attracted significant interest during recent years due to the fact that they are readily synthesized through a simple procedure and extremely useful in nanoscience studies [2].

This work is focused on the fabrication of AAO in thin films applications. A new electrochemical approach was developed for selective oxide barrier perforation using of re-anodization technique for micro sensors application. The skip phasing of oxide barriers wet etching is the significant advantage of re-anodization. The dissolution of oxide barrier is carried out in the same acid such as the anodization process and the perforation is controlled only by current density and applied voltage.

The microsystem, which represents small comb-like electrochemical sensors system, was prepared by deposition of gold microstructures on silicon, silicon oxide and titanium multilayer. The thin aluminum film (2 μm) was deposited on surface of electrodes by evaporation method. The thin porous anodic alumina template was prepared by one-step oxidation process under potentiostatic voltage (40 V) in 0.3 M oxalic acid at 17 °C [3]. The anodization process ran to the point where the current density started to increase. At this time, all aluminium was consumed and the oxide barrier started to be dissolved. The continuous application of voltage caused complete dissolution of oxide barrier, approximately after 15 seconds. For the next application the opened alumina template could be used for the electrodeposition of nanowires or nanotubes with the same length and diameter as the template. The surface morphology and homogeneity of the fabricated samples were investigated with MIRA II Tescan scanning electronic microscope operated at 1–30 keV in high vacuum mode. The impedance spectroscopy was provided (Agilent 4284A) to characterize opening of nanoporous alumina. The original porous structure can be seen on Fig. 1. The pore diameter was in range of 30–80 nm and thickness was 2 μm.

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References

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Figures

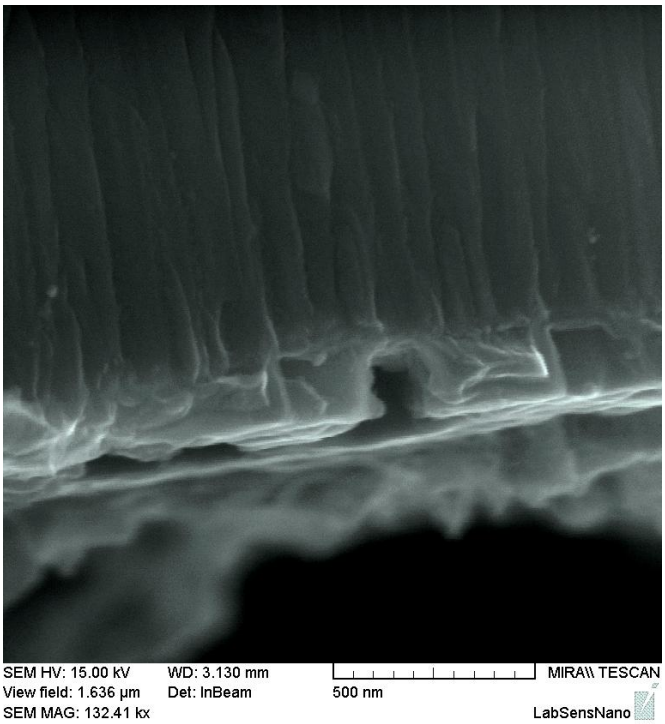

Fig.1. SEM cross-section image of nanoporous oxide alumina with perforation barrier