FABRICATION OF IMPEDIMETRIC GAS SENSOR WITH Au/TiO_2 ORDERED STRUCTURE ON MICROHOT-PLATE SYSTEM

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Recent research showed the availability of atmospheric pollutant monitoring using a gas sensor with a nanostructured surface of sensing electrode which can be prepared through anodisation process [1]. The use of the anodisation technique for obtaining oxide porous material which can be used e. g. as nano-template was firstly reported in the work of Masuda *et al.* [2]. The aim of presented work is a fabrication of Au nanorods further modified with TiO_2 layer for the improving of electrode sensing properties due to increasing its specific surface.

The impedimetric microsystem, which represents microhot-plate gas sensors, was prepared by the deposition of $POCl_3$ doped polysilicon heater and gold comb-like microstructures. The thin aluminum film (2 µm) was deposited by evaporation method on the gold microstructures. The thin porous anodic alumina template was prepared by one-step oxidation process under potentiostatic voltage (40 V) in 0.3 M oxalic acid [3, 4]. The anodisation process ran to point where the current density started to increase. The pore diameter was in the range of 30–80 nm and thickness was 2 µm. The original porous structure can be seen on the steps break (Fig. 1). Close to the base layer the porosity and ordering grow up. SEM analysis showed several advantage of this technique. First, the porous alumina grew up only on a conducted micro system, despite the theory of growing on all surface of aluminum layer [5, 6]. This fact was caused by differences between the thickness of aluminum on conductive layer and on the other areas (Fig. 2). The porous alumina started to grow on whole surface. After few seconds, the current density was higher in aluminum on conductive layer in comparison with the other space and therefore the porous alumina was obtained only on small conductive areas.

The second advantage is a skip phasing of oxide barrier chemical etching. The oxide barrier was successfully removed by continual anodization under a constant potential. Despite the previous experience, it is not necessary to use a phosphoric acid for dissolving of oxide barrier [7, 8]. The barrier is very thin. Since all aluminum is consumed, the oxide barrier starts to be dissolved due to high electric potential on interface conductor – oxide.

Finally, the alumina template was used for the galvanic deposition of gold nanowires with the same length and diameter as pore sizes of the template [9]. The cross section image (Fig. 3) shows the gold nanowires after dissolution of alumina in 5 % NaOH.

Next step was aimed to immobilization of TiO_2 coatings by sol-gel technology starting from titanium tetrapropoxide precursor, ethanol as solvent and acetyl-acetone as stabilizing agent. The concentration of Ti was 0.35 mol dm^{-3}. The sol was simply dropped onto Au nanomachined surface of comb-like structure, then dried at 110 °C in oven and finally annealed at 450 °C in a furnace. Raman spectroscopy was employed to characterize TiO_2 phase constitution (Fig. 4).

References:

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Figures:

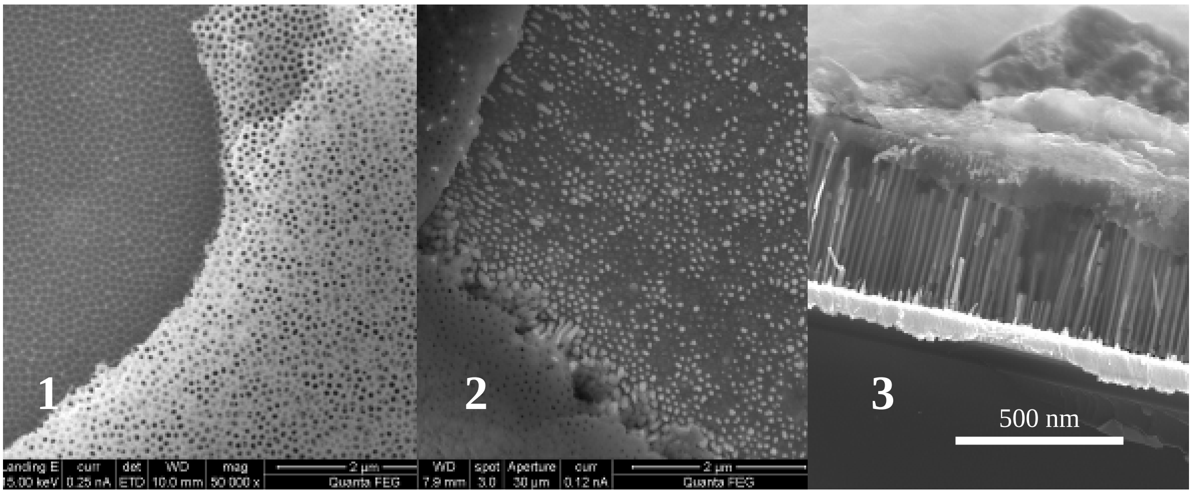

Fig. 1-3 *SEM analysis of nanomachined microelectrodes*

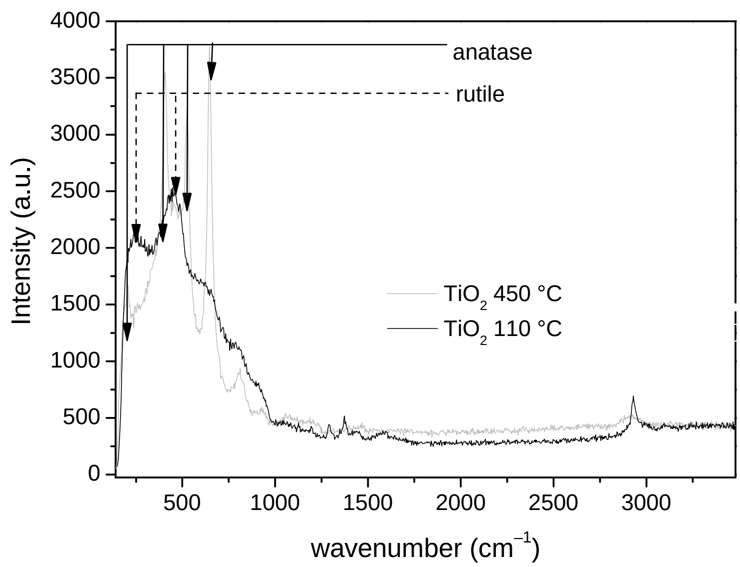

Fig. 4 *Raman spectra of TiO_2 annealed at 110 °C and 450 °C*