NANOELECTRODES FOR BIOPHYSICAL MEASURMENTS

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Abstract: In-vivo impedance measurement of cells is the objective of current scientific research in area of biological sciences. The problem that needs to be solved is how the cells can be contacted with electrodes. One possible solution can be based on nanoelectrodes that could be fabricated due to current high technology level. The main goal of this work is to design and create nanoelectrodes using thin-film techniques together with lithography and nanotechniques developed in LabSensNano. The work is engaged in UV and e-beam lithography, and in preparation of silicon wafers. Furthermore a brief electrodes design, fabrication concept and current state of the experiment are proposed.

Keywords: Lithography, photo resist, cleaning, nanoelectrodes, masking, wave length, developing

1. INTRODUCTION

Nowadays there are a lot of techniques for developing nanosensors. Due to the size what we want to achieve, the thin-film techniques are necessary to be used. Implementation of nanosensors and nanoelectrodes belong to the field of microelectronics, but significant parts of implementation needs chemical and electrochemical processes. My task was a technical design and fabrication of two nanoelectrodes for biophysical measurement. Used techniques and equipment were specified by project supervisor.

2. DESIGN AND IMPLEMENTATION

During the technical design, the disposal equipment and recommended technologies were taken into attention. The electrode pair´s main parameters are the size of the electrodes, used material and the layout. These electrodes are predestinated to be used for measurement of human cells with diameter of 10 um, therefore the tip size of 40 x 40 nm was chosen. The recommended materials are titan or gold. [2]

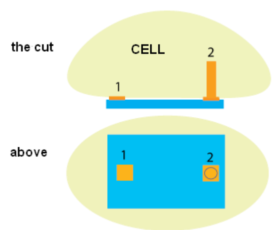

Figure 1- Contact between the electrodes and the cell’s surface

One of the most important parts of the implementation is lithography. Based on the supervisor´s advices and the required parameters was decided to use ultra violet (UV) and electron beam (e-beam) lithography. The shape of electrodes depended on the type of measurement. First electrode must be contacted with cell´s surface and the second electrode must be contacted inside the cell as is shown in the figure 1.

2.1. OUTLINE OF IMPLEMENTATION

The implementation has three main steps. The first step is about the contacts between nanoelectrodes and measuring device as is shown in the figure 2. Second step is about the creation of base part of nanoelectrodes (see Fig. 3). Third part involved electrochemical processes for creation aluminum oxide layer and galvanization for creation of gold nanowire on the surface one of the contacts as is shown in the figure 4.

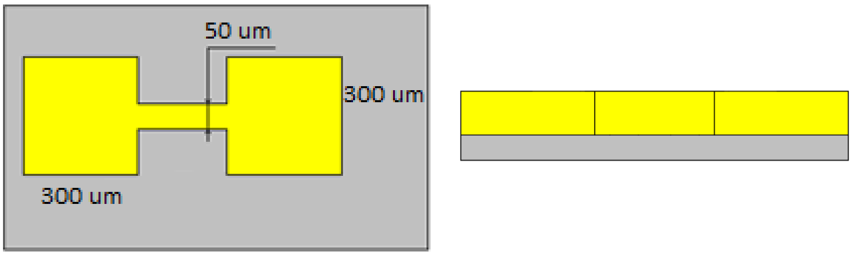

Figure 2- outline of the first step, top view (left), side view (right)

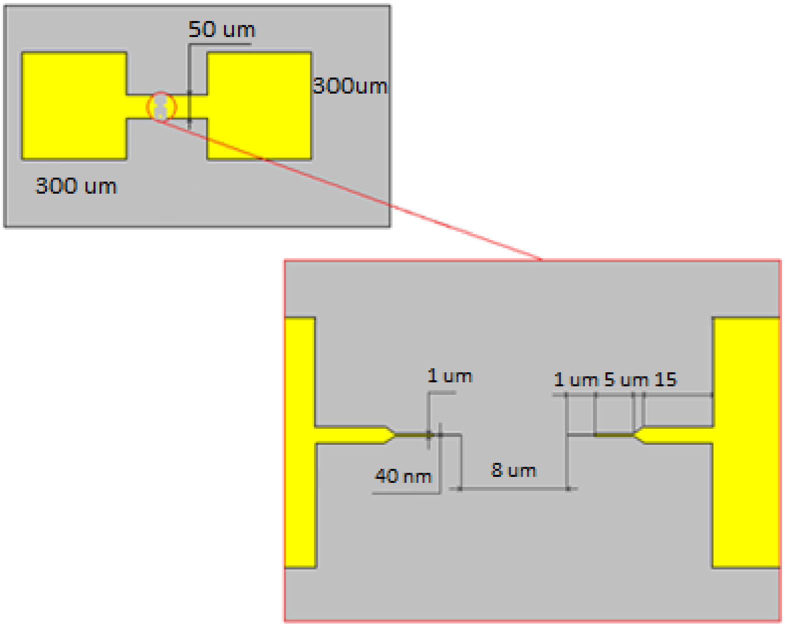

Figure 3- outline of the second step

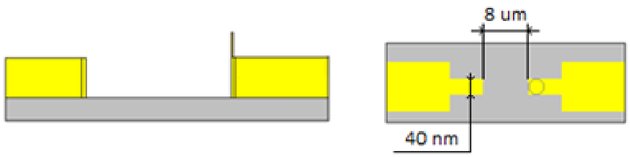

Figure 4- outline of the third step, side view(left), top view(right)

2.2. EQUIPMENT AND DEVICES

Main part of practical work is done in the chemical laboratory. During the fabrication two types of photo resist – negative Su-8 2 and positive PMMA 495 from Microchem Corp., some chemicals for cleaning of silicon wafer, resist developers and etching solutions were used.

Used photo resists are coated on the silicon wafer using spin coater. The negative photo resist is exposed with I-line UV light, but I-line UV light has no effect on positive photo resist. [3] The fabrication of base part of nanoelectrodes was done using scanning electron microscope TESCAN MIRA LMU with nanolithography facilities.

3. CONCLUSION

In this work, the nanoelectrodes for biophysical measurements were studied, designed and partially fabricated. The theoretical part of this work is mainly focused on the processes of lithography and its types. In practical part were done the first step using negative photo lithography and etching processes and partially the second step. The future work will be focused on the second step optimization and the final step of the electrodes fabrication.

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