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Masks and metallic electrodes compounds for silicon biosensor integration

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Abstract. **The biosensors coupled to Field Effect Transistors, briefly labelled as BioFET, require the co-integration of the bio-receptor elements with the electron device. This demand involves compatibility among the technologies and materials. This paper presents the main fabrication steps of an enzymatic transistor designed to be sensitive to glucose. The main technological flow is based on the classical MOSFETs microelectronic technology in 6 masks, plus a sensitive detection area, configured across the gate space by the 7-th mask, dedicated to bioreceptors. To anchor the enzyme layer onto a Silicon wafer, an intermediary nano-structured TiO_2 layer grown by anodization is firstly used. The TiO_2 material offers an optimum nano-porosity and biocompatibility with the enzyme. For the glucose-oxidase enzyme immobilization, the nafion and finally the glutaraldehyde agent is used as crosslink polymerization elements. The surface characterization is performed by ATR-FTIR spectroscopy and SEM imaging. Finally, in a discussion section, further details to support the BioFET functionality, are provided.**

Keywords (*from the list of the* Journal of Alloys and Compounds)*: nanostructured materials; electrode materials; semiconductors; thin films; nanofabrications; SEM imaging*

1. Introduction

In the last decades, the microtechnology field evolved toward nanotechnologies and rapidly diversified the compounds used in the sensors fabrication [1, 2]. The main integrated sensors, with incorporate electron devices as transducers, are still produced in a white room, appealing to the standard microelectronic processes. But, the manufacturing of an integrated biosensor require an interdisciplinary approach, starting from the metallic masks design [3] and fabrication, passing thru a complex microtechnological flow and finishing with biomaterials entrapping onto different compounds, [4, 5]. On the other hand, the silicon technology was demonstrated to produce optimum quality/costs ratio for the most complex devices, including acoustic devices [6] or integrated biosensors [7].

Several research groups are focused on biosensors that integrate the biodetector layer within the gate space of a Field Effect Transistor (FET), using nanoporous integrable compounds, like Si-porous [8], Al_2O_3-nanoporous [9], Carbon Nano-Tubes (CNT) or others. The resulted Biosensor coupled to a Field Effect Transistor is briefly abbreviated as BioFET. More recent, some biosensors tend to use the TiO_2-nanomaterials as intermediate layer, due to the excellent biocompatibility between Titanium compounds and the living matter [10]. It is wellknown that the Ti-compounds succesfully enter into the construction of a lot of implantable prostheses, [11]. The solution of TiO_2-nanotube purchasing, followed by subsequently deposition isn't suitable for the electronic devices co-integration, due to an extremely small area of processing and non-exfoliation conditions, [12]. The Ti thin films conversion into nanostructured-TiO_2 layers becomes a promissing solution for integration purposes, [13]. If additionally, non-Titanium alloys are selected for the source and drain transistor electrodes, keeping the TiO_2 as the gate material, some additional metal sources (e.g. Al, Pt etc), accompanied by specific technological resources would be necessary, increasing the costs, [14].

Therefore, in this paper, the common metal resource used both for the source / drain metallic contacts and for the gate nanostructured compound is Titanium. Appealing to an excellent Ti/Au electrodes combination, a novel aim of this paper is to monitor these metallic compounds that accompany the global technological flow of the glucose