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Department of Microelectronic Technology

Silicon ultra fast cameras for electron and gamma sources in medical applications
SUCIMA GRD2-2000-31832

COORDINATOR

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- Institute of Nuclear Physics, Cracow, Poland,
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- Institute of Electron Technology, Warsaw, Poland
- CNRS - Alsace, France
- ZAG - Zyclotron AG, Karlsruhe, Germany
- Eurotope, Berlin, Germany

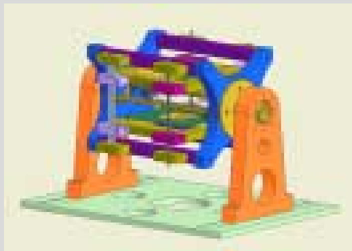
OUR ROLE IN THE PROJECT

SOI technology development. Technological design, production and characterisation of a SOI active pixel imager of ionizing radiation.

PROJECT DESCRIPTION

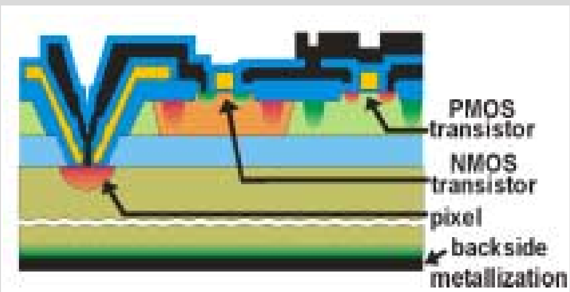
The goal of the proposal is the development of an advanced radioactive source imaging technique, to be used in medical applications. A fast imaging of extended radioactive sources would boost the progress in radiotherapy applications including angioplasty and treatment of tumors with use of ion accelerators. The main project outputs are the production of the advanced radiation imaging devices (including complete read-out systems) and the improvement in the radiotherapy methodology. The monolithic sensors are to be designed in two different technologies – submicron CMOS (Complementary Metal Oxide Silicon) and SOI (Silicon On Insulator). It is believed that the both implementations of the same architecture design should be pursued to maximize the possibility of success as the critical technological steps are quite different. Moreover, the different implementations offer complementary advantages. The main innovation of the proposed system is defined by the granularity of the source image, the speed of the acquisition system and the high level of integration of the functionalities on the same chip, requiring frontier microelectronics technology.

The space dosimeter designed for the SUCIMA project.

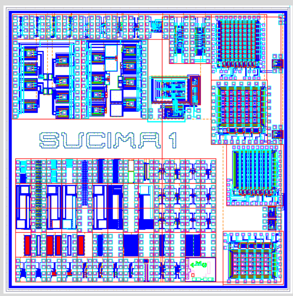


RESULTS

Silicon On Insulator (SOI) wafers consist of a silicon film over an insulating layer (silicon dioxide, called Buried Oxide - BOX) on a silicon substrate. The CMOS techniques based on SOI wafers guarantee that many parasitic effects which are critical for the conventional bulk circuits are much less relevant or even negligible in SOI CMOS circuits. In the classical SOI technologies, the substrate acts only as mechanical support for the silicon film. In our specific application, the substrate is intended to have a high resistivity and act as the particle sensor, monolithically coupled to the readout electronics integrated in the silicon film over the BOX. Since no monolithic sensors of ionizing radiation have ever been successfully designed on high resistivity SOI wafers and moreover a hybrid detector suitable for the applications mentioned in Project Description does not exist off the shelf, it is planned to validate separately the read-out architecture and the technology. The role of the IET is to develop a new SOI technological sequence and to validate it by performing suitable experiments on a specially designed test structure. In the meantime, the read-out concept will be examined by use of a commercial CMOS technology on classical (non-SOI) silicon substrates. After these steps the SOI technological file delivered by the IET will serve for final imager design and the sensors are to be fabricated at the IET facilities. At the end of the first year of SUCIMA project the first version of the technological sequence has been designed resulted from integration of pixel manufacturing technique with typical CMOS poly-Si gate technology. The sequence has been partially validated with use of monolithic test structures manufactured on commercial SOI low resistive substrates. In the meantime the specialized SOI test structure has been designed and set of masks fabricated.



On the left - the cross-section of the SOI sensor. The front-end electronics is in the upper silicon layer (above blue colored BOX), the main sensor junction being charge collector (pixel junction) is formed below BOX. On the right - the overall view of the specialized SOI test structure. The technological part of the structure has been designed in the Department of Integrated Circuits & Systems.



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