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SiCILIA - Silicon Carbide detectors for nuclear physics and Applications

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Silicon carbide (SiC) is a semiconductor material with highly suitable properties for high-power, high-frequency, and high-temperature applications. Silicon carbide (SiC) is a semiconductor with a wide, indirect band gap. Among all the wide band gap semiconductors, silicon carbide is presently the most intensively studied one and the one with the highest potential to reach market maturity in a wide field of device applications. It is a wide bandgap semiconductor with high breakdown electric field strength, high saturated drift velocity of electrons, and a high thermal conductivity. For these physical and electrical properties in many fields SiC overcomes silicon (Si), that is the dominating material of electronic industry.
The chemical and physical material properties are promising for high temperature and high radiation operation conditions [1]. The potential application of SiC as radiation hard material for detectors implementation and the possible use in several new INFN projects (NUMEN,NuReLP, ELIMED, FAZIA etc.) have led to the birth of a cooperation between INFN and IMM-CNR for a common R&D activity on Silicon Carbide technology named SiCILIA (Silicon Carbide detectors for Intense Luminosity Investigations and Applications) which has been totally funded by INFN. SiC diodes are predicted to be radiation harder than Si due to the high displacement threshold and potentially used as detectors in high radiation conditions. The remarkable progresses in the material growth process [2] and device technology of the last years, allowed to realize high performances SiC devices based on p-n junction [4]. They have been used to detect neutrons, X-rays, protons, alpha particles and heavier ions [5]. For nuclear community is very important the realization of detection system that can operate with high fluxes (10ˆ7 pps/mˆ2) and fluences (10ˆ14 cmˆ-2) of heavy-ions in order to determine the cross sections of very rare phenomena (i.e. such as double charge exchange reactions). Silicon carbide technology offers today an ideal response to such challenges, since it gives the opportunity to cope the excellent properties of silicon detectors (resolution, efficiency, linearity, compactness) with a much larger radiation hardness (up to five orders of magnitude for heavy ions [6]), thermal stability and insensitivity to visible light. In the framework of SiCILIA [6] activities, several measurements have been performed on SiC prototypes, by using radioactive source and ions beams. In the contribution we discuss the project and the main results comparing also the SiC performance with that of others standard detectors.
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Primary author: Dr TUDISCO, Salvo (INFN-LNS)

Presenters: Dr TUDISCO, Salvo (INFN-LNS); LA VIA, Francesco (CNR IMM)

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