SiC NUCLEAR RADIATION DETECTORS

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Silicon carbide (SiC) is a promising material for fabrication radiation-tolerant electronics, high-temperature electronics as well as for nuclear radiation detectors working in harsh environments. Mainly, 4H-SiC polytype is mostly investigated for its physical properties, e.g.: the band gap energy is 3.26 eV, the mean energy of electron-hole pair creation is 7.78 eV, the electron saturation drift velocity is $2x10^7$ cm/s and the breakdown voltage is $2x10^6$ V/cm at room temperature. Detectors based on high quality epitaxial layer of 4H-SiC show a high radiation resistance [1, 2] and good spectroscopic performance, at room and also at elevated temperatures (> 300°C) [3].

Detector structures [4] were prepared from a 70 μm thick nitrogen-doped 4H-SiC layer (donor doping ~ l x 10^{14} cm^{-3}) grown by the liquid phase epitaxy on a 3" 4H-SiC wafer (donor doping ~ 2 x 10^{18} cm^{-3}, thickness 350 μm). The Schottky barrier contact (Au/Ni with thicknesses 30 and 10 nm) with diameter of 2.0 mm was formed on the epitaxial layer through a contact metal mask, while full area contact from Ti/Pt/Au was evaporated on the other side (substrate).

Electrical characteristic of prepared SiC detectors were measured using Keithley measuring complex, which consisted of 4200A-SCS Parameter Analyzer, 4200A-CVIV Multi-Switch, 2657A High Power System and CVU-3K-KIT, which allow to perform high voltage I-V and C-V measurements up to 3000V.

SiC detectors were used in experiments at the IC-100 cyclotron of the Joint Institute for Nuclear Research in Dubna. The degradation of SiC detectors under impact of the high-energetic beam of heavy ions of xenon were studied, as well as the effect, which is known in the literature as Pulse Height Defect [5]. The radiation resistance of SiC detectors was almost a hundred times higher as for Si detectors. High radiation resistance of SiC detectors and their good energy resolution allow one to use these devices for long-term monitoring of heavy ion beams.

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