Contribution ID: **42** Type: **not specified**

Study of the spectrometric performance of SiC detectors at high temperature

Wednesday 22 June 2022 09:20 (20 minutes)

In future nuclear fusion reactors, it will be essential to diagnose suprathermal ions escaping from the plasma. The escaping suprathermal ions imply a loss of energy that leads to plasma cooling, in addition to compromising the integrity of the reactor wall material [1]. For the future ITER (International Thermonuclear Experimental Reactor) project, it will be of crucial importance to detect the 3.5 MeV alpha particles resulting from the D-T reaction. Nowadays, Fast Ion Loss Detectors (FILD) based on scintillation materials are the most widely used in magnetic plasma confinement devices [2], but these diagnostic systems have limitations in accomplishing the specifications needed to perform this task due to the high radiation and temperature levels. At this time, one of the best alternatives is to use semiconductor detectors. Silicon carbide is a broad bandgap material with high thermal conductivity (3.7 W/(cm-℃)), which makes it suitable for high temperature applications. In this work, the spectroscopic performance of a 4H-SiC Schottky diode, fabricated by the Institute of Microelectronics of Barcelona (IMB), for the detection of 3.5 MeV alpha particles in the temperature range from room temperature (RT) to 450 ℃ is studied. In addition, the measured spectra have allowed to obtain the average electron-hole pair creation energy as a function of temperature with higher precision than in other works that can be found in the literature.

[1] A. Fasoli et al., Chapter 5: Physics of energetic ions. Nuclear Fusion 47, S264 (2007).
[2] M. Rodríguez-Ramos, M.C. Jiménez-Ramos, M. García-Muñoz, J. García López, Temperature response of several scintillator materials to light ions. Nuclear Instruments and Methods B 403 (2017) 7-12.

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Session Classification: Wide Band Gap Materials