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Use of a nuclear microbeam to study the radiation hardness of SiC detectors

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Abstract

The harsh operating conditions of the next generations of fusion reactors will put to the test, or even disable, some of the diagnostic and measurement systems that are used today in plasma devices based on magnetic confinement. Finding an alternative to the current detection systems, usually formed by a combination of photomultipliers and scintillation layers, is crucial to face the working conditions of the future ITER.
In this work, the use of a detector based on a Wide BandGap (WBG) semiconductor material, such as SiC, is proposed. One of its main advantages is that it is operational at high temperatures (up to 500ºC or more) and has good radiation hardness. The detector used in this investigation is a 4H-SiC diode fabricated at Centro Nacional de Microelectrónica (CNM-CSIC).
Here, we present the preliminary results of the degradation in Charge Collection Efficiency (CCE) after irradiation with 3.5 MeV He ions, which are one of the reaction products of the D-T fuel that will be used in ITER. The study was carried out at the microbeam line of the Centro Nacional de Aceleradores. Nine different areas 100x100 μm2 were irradiated to create controlled damage at fluences from 0.5x1010 to 5x1011 ion/cm2. The Ion Beam Induced Charge (IBIC) technique was employed to determine the decrease in CCE at different bias voltages.

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