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Response of SiC diodes to Low-Energy Proton Beams under FLASH conditions at CNA

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In recent years, FLASH radiotherapy has gained attention as a promising approach to reduce damage to healthy tissues while maintaining effective tumor control. To meet the requirements for FLASH, ultra-intense pulsed beams—dose rates exceeding 40 Gy/s—must be achieved. This has created the need to develop facilities capable of conducting experiments at sufficiently high rates as well as detectors with the potential of correctly measuring the accumulated dose..

In this work we investigate the response of SiC p-n diodes, with a 30-micron diameter and a nominal thickness of 3 microns, developed at IMB-CNM (CSIC) to low-energy pulsed proton beams and ultra-high accumulated doses. The experiments were conducted with 1 MeV and 2 MeV proton beams at the 3 MV Tandem accelerator of the National Accelerator Center (CNA) using a custom-built pulsed beam system.

It was demonstrated that the CNA can irradiate under Ultra High Dose Rate (UHDR) conditions, with pulse durations on the order of microseconds (~µs), achieving dose rates of up to 10 kGy/s, dose-per-pulse values of 5.6 Gy, and dose rate-per-pulse of 4.6 MGy/s.

The results indicate that the sensors response degrades for doses between 70 and 800 kGy, after which a plateau is reached. Once this plateau is achieved, the sensors exhibit a linear response over the entire range of dose rates tested, up to doses of at least 5 MGy.

Abstract

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