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Determination of the Relative Defect Density in Semiconductors Using SPA-TCT and TPA-TCT Method

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This study investigates the sensitivity of the Single-Photon Absorption Transient Current Technique (SPA-TCT) and the Two-Photon Absorption Transient Current Technique (TPA-TCT) to variations in defect density within semiconductor materials. Controlled ion implantation was performed on silicon pin detectors using four ion species (1H, 14N, 16O and 28Si), at different energies to create well-defined traces of structural defects at different depths. Among them, silicon ions were used to reproduce the displacement of atoms originally located at lattice sites, simulating the effect of a neutral particle interaction.

The implantations were carried out at the microprobe line of the 3 MV Tandem accelerator at the National Accelerator Center (CNA, Seville). Using a pulsed beam system and our nuclear microprobe line, for each ionic species 9 different micrometric regions were irradiated in a single device, varying the number of ions between 1 and 10e5 to create damaged regions with very different defect densities.

SPA-TCT and TPA-TCT measurements were subsequently performed at the Solid-State Detectors (SSD) laboratory at CERN. Preliminary results show that both techniques can resolve spatial variations in defect density only above certain fluence levels, while low-fluence regions remain below the detection threshold. TPA-TCT exhibits enhanced depth discrimination and higher sensitivity at low defect densities, whereas SPA-TCT becomes more sensitive for regions with higher damage levels. These results highlight the complementarity of both techniques for the characterization of radiation-induced defects in semiconductor detectors.

Type of presentation (in-person/online)

in-person presentation

Type of presentation (I. scientific results or II. project proposal)

I. Presentation on scientific results

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