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Characterization of MOSFET sensors for dosimetry in alpha particle therapy

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Alpha particle therapy, such as diffusing alpha-emitters radiation therapy (DaRT) and targeted alpha-particle therapy (TAT), exploits the short-range and high linear energy transfer (LET) of alpha particles to destroy cancer cells locally with minimal damage to surrounding healthy cells. Dosimetry for DaRT and TAT is challenging, as their radiation sources produce mixed radiation fields of α particles, β particles, and γ rays. There is currently no dosimeter for real-time in vivo dosimetry of DaRT or TAT. Metal-oxide-semiconductor field-effect transistors (MOSFETs) have features that are ideal for this scenario. Owing to their compactness, MOSFETs can fit into fine-gauge needle applicators, such as those used to carry the radioactive seeds into the tumour. This study characterized the response of MOSFETs designed at the Centre for Medical and Radiation Physics, University of Wollongong. MOSFETs with three different gate oxide thicknesses (0.55 µm, 0.68 µm, and 1.0 µm) were irradiated with a 5.5 MeV mono-energetic helium ion beam (He2+) using SIRIUS 6MV accelerator tandem at the Australian Nuclear Science and Technology Organization (ANSTO) and an Americium-241 (241Am) source. The sensitivity and dose-response linearity were assessed by analysing the spatially resolved median energy maps of each device and their corresponding voltage shift values. The results showed that the response of the MOSFET detectors was linear with alpha dose up to 25.68 Gy. Also, it was found that a gate bias of between 15 V and 60 V would optimize the sensitivity of the detectors to alpha particles with energy of 5.5 MeV.

Level of Expertise

Student

Presenter Gender

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Which facility did you use for your research

Centre for Accelerator Science

Students Only - Are you interested in AINSE student funding

Yes

Do you wish to take part in the Student Poster Slam

Yes

Condition of submission

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