Semiconductor Microdosimetry and its applications in particle therapy and space

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Based on many years of experience in development of silicon-on-insulator (SOI) microdosimeter, the Centre for Medical Radiation Physics, University of Wollongong, has successfully developed a microdosimetric probe which is based on a SOI microdosimeter with 3D micron sized sensitive volumes (SVs) array mimicking dimensions of cells, known as the "MicroPlus-Mushroom" microdosimeters, to address the shortcomings of the tissue equivalent proportional counter (TEPC)

A method for converting silicon microdosimetric spectra to tissue for a therapeutic proton and heavier ion beams, based on Monte Carlo simulations was developed. The MicroPlus microdosimeter provides extremely high spatial resolution and were used to evaluate the relative biological effectiveness (RBE) of ^{12}C, ^{14}N ^{16}O , ^{56}Fe, ^{20}Ne ions at Heavy Ion Medical Accelerator in Chiba (HIMAC), Japan as well as to measure the microdosimetric distributions of a proton pencil-beam scanning (PBS) and passive scattering system at different proton therapy centres. Good agreement between predicted cell survival response using MKM and measured from *in vitro* experiments in the same radiation field allow replacing time consuming cell experiments with MicroPlus microdosimeter measurements.

Another application of SOI microdosimeter is for evaluation of radiation shielding and radiation protection of astronauts in radiation environment typical for SPE and GCR. We demonstrated that SOI microdosimeters are suitable for *in situ* evaluation of radiation shielding efficiency of multi-layered space craft and astronaut shelter walls in radiation fields on accelerators mimicking SPE and GCR. SOI microdosimeters supplement Monte Carlo simulation which not always accurate due to lack of knowledge of cross sections and time consuming.

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