Contribution ID: **119** Type: **not specified**

Silicon-based micro-dosimeters for advanced radiation therapies

Radiotherapy is used for the treatment of cancer in almost 50% of the patients, both for curative or palliative aims. The introduction of advanced techniques such as hadrontherapy, based on the use of protons and heavier charged particles, i.e. carbon ions, is currently a growing modality of radiation therapy. These particles deposit a larger amount of energy per unit particle track length than conventional RT sources and they create a highly conformal high dose region with the possibility of covering the tumor volume with high accuracy, while at the same time delivering lower doses to the surrounding healthy tissue. In 2016, according to data from the Particle Therapy Co-Operative Group, there are 61 particle therapy centers in the world with 32 others under construction (19 and 10 in Europe, respectively).

Treatment planning systems are used to determine the dose distribution obtained for a certain beam arrangement to be applied to a tumor volume. In the case of hadrontherapy, this is challenged by the need to account for the different radiobiological efficiency (RBE) of the beam depending on its primary energy and depth in tissue. This RBE has to be modelled and used in the treatment to optimize the tumor control probability and minimize unintended side effects due to normal tissue irradiation.
Using radiation microsensors that can experimentally verify microdosimetric characteristics would have a fundamental impact on treatment planning. In fact no adequate bio-dosimeters are currently available for the routine verification of biological dose in hadrontherapy. Existing methods are software-based using Monte-Carlo simulations, or based on gaseous chambers that have cm3 volumes, suffer from wall effects, require a gas supply, perturbate the fluence significantly and provide only single-point measurements.

Silicon-based device fabrication can produce tailor-made micrometer-scale micromachined structures. Additionally, silicon sensors are operated at low voltages, are small and portable with fast time response. The Spanish National Center of Microelectronics (IMB-CNM, CSIC), building on more than 15 years'experience of producing advanced silicon detectors for nuclear and high energy physics experiments, has developed a **silicon microsensor technology that can provide cell-like silicon sensitive volumes to allow for unprecedented spatial and dose resolution**. Proof-of-concept devices have already been used to characterize with high accuracy the radiation quality parameters of carbon and proton beams.

Our goal is the realization of a **complete microdosimetry system for the verification of the biological efectiveness of hadron treatment plans based on this novel silicon technology**. We propose to address this challenge with a well balanced multidisciplinary team with a strong combination of expertise including microelectronics technology, electronics, system integration, data processing, Monte-Carlo simulation, radiation therapy and radiobiology.

Summary

Keywords: Radiation science and engineering, advanced radiation applications, hadrontherapy, dosimetry.

Primary author: Dr FLETA, Celeste (Instituto de Microelectrónica de Barcelona, Centro Nacional de Microelectrónica (ES))

Co-authors: Dr GUARDIOLA, Consuelo (IMNC-CNRS); GOMEZ, Faustino (Universidad de Santiago de Compostela); Dr PELLEGRINI, Giulio (Centro Nacional de Microelectrónica (IMB-CNM-CSIC) (ES))

Presenter: Dr FLETA, Celeste (Instituto de Microelectrónica de Barcelona, Centro Nacional de Microelectrónica (ES))