CHARACTERIZATION OF RAD-HARD SILICON DIODES AS DOSIMETERS FOR SMALL FIELDS OF PHOTON AND ELECTRON BEAMS USED IN RADIOTHERAPY

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Introduction: The response of rad-hard silicon diodes for radiotherapy electron beam dosimetry has been investigated with plastic phantoms [1]. Improvements in sealing the diodes with a thin epoxy layer have allowed their dosimetric characterization in water, as required in radiotherapy beam data acquisition. These results obtained with rad hard Float Zone (FZ) silicon diodes (25 mm^2 of active area) as dynamic dosimeters for electron beams are presented in this work. The study of feasibility of using a very small (6.25 mm^2) rad-hard FZ diode on the dosimetry of small fields of photons and electrons beams is also under way.

Experimental: The FZ diodes used were processed on n-type bulk material of 300 μm thickness [2]. In order to use the diodes as dosimeters, they were housed in a black polymethylmethacrylate probe, with their front layer sealed with a 2.0 mm resine thick layer to provide protection from mechanical stress, light and water. The dosimetric response of the devices was evaluated for 9, 12 and 20 MeV electron beams from a Varian Medical Systems Novalis-TX® Radiotherapy Linac, located at Sírio-Libanês Hospital. All measurements were performed with the diodes unbiased and directly connected to a Keithley 6517B electrometer.

Results and Discussion: For electron beam energies from 9 MeV up to 20 MeV, the dose response curves of the FZ diode (25 mm^2) are quite linear with charge sensitivities higher than 0.5 nC/Gy (Fig.1). The measurements of the PDD for 12 MeV and 20 MeV electron beams are presented for this sample in Fig.2, together with simulation results based on Monte Carlo calculations performed using Eclipse TPS's and MC, Varian Medical Systems®. It can be seen a satisfactory agreement between data, despite the high predose (1.5 MGy) accumulated in this FZ diode. The linearity study shows, as a first hint, that the diode presents non dose rate dependence, at least within the range from 100 MU/min to 600 MU/min (Fig.3). These results encourage us to investigate the use of a 6.25 mm^2 rad-hard FZ silicon diode on the dosimetry of small fields of photons and electrons clinical beams. These studies are under way.

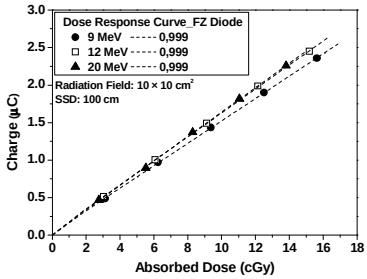

Fig. 1 – Dose-response curves of FZ diode for 9, 12 and 20 MeV electron beams.

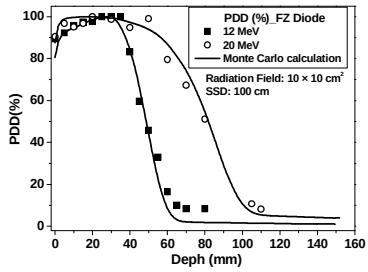

Fig. 2 – PDD profiles compared with Monte Carlo calculation.

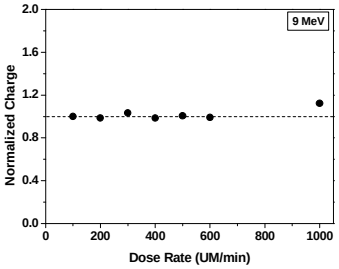

Fig. 3 – Sensitivity of FZ diode as a function of dose rate for 9 MeV electron beam.

References:

[1] Santos, T. C. et al. **2011**. Evaluation of rad-hard epitaxial silicon diode in radiotherapy electron beam dosimetry. Radiat. Meas. *46*, 1662-1665.

[2] Härkönen, J. et al. **2004**. Radiation hardness of Czochralski silicon, Float Zone silicon and oxygenated Float Zone silicon studied by low energy protons. Nucl. Instr. And Meth. A. *518*, 346-348.