AbstractID: 10883 Title: Characterization of MOSFET Dosimetry System for Source Position Verification in HDR Brachytherapy

Purpose: To test the Metal-Oxide-Semiconductor Field Effect Transistor (MOSFET)-based method for HDR Brachytherapy source tracking and to assess how accuracy and precision of the method changes with the MOSFET reading fluctuations and the number of dosimeters.

Methods and Materials: Three standard MOSFET dosimeters connected to a high sensitivity bias supply were placed at fixed positions, 3 to 7 cm from the Ir-192 source, driven by a Remote Afterloader (VariSource iX, Varian Medical Systems Inc.), within a solid water phantom. Six source dwell positions were planned. MOSFETs calibration was performed at a distance of 3 cm from source. MOSFET characteristics, including energy and angular dependence, dose linearity and reading variation in time, were established. A Matlab optimization code, based on the minimizing the sum of the normalized squared differences between the measured and analytically calculated dose values, was developed for source position calculation. Randomly generated measurement errors 1 to 8% were added to MOSFET readings to assess the method accuracy and precision degradation. The effect of the MOSFETs number on the system performance was also studied.

Results: Measurements with three MOSFETs result in 0.2 to 1.9 mm deviations between calculated and actual source positions, with average of 0.8 mm. If fluctuations added to the MOSFET readings are of 1% of the reading value, accuracy of (0.7±0.3) mm is achieved, while fluctuations of 8% result in (5.2±2.6) mm accuracy. Increase in the number of MOSFETs until 12 results in improved accuracy of (0.3±0.2) mm and (2.9±1.5) mm for 1% and 8% high fluctuations, correspondingly.

Conclusions: The study showed the potential of the method to verify the position the HDR Ir-192 and to improve the quality control in HRD Brachytherapy. Increasing the number of MOSFET detectors improves the accuracy of the method even for higher MOSFET reading uncertainties.