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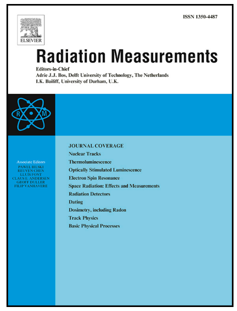

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6MV LINAC characterization of a MOSFET dosimeter fabricated in a CMOS process

M. Garcia-Inza(1), M. Cassani(1), S. Carbonetto(1), M. Casal(2), E. Redín(3), A. Faigón(1)

Abstract

This paper presents the characterization of a thick gate oxide MOSFET for radiotherapy in-vivo dosimetry. The device is an N-channel transistor fabricated in a standard CMOS process using the Field Oxide as gate insulator. Sensitivity, fading, gate bias voltage dependence, percentage depth dose and angular response were assessed using a 6 MV LINAC. Experimental results showed that it is possible to estimate dose with a 3 % uncertainty in a range up to 85 Gy with an average sensitivity of 62 mV/Gy. The measurement system noise equivalent dose is 3 mGy.

Key words: MOSFET; in-vivo dosimetry; radiotherapy; CMOS

1. Intro

In-vivo dosimetry (IVD) is a recommended practice for safety and quality assurance (QA) in radiotherapy applications [Purdy, 2006]. Independent dose measurements are necessary to prevent radiotherapy accidents and for early detection of deviations from the planned treatment. Hence, IVD allows to introduce corrections along the treatment avoiding under- or over-exposure which can result in the reduction of the treatment efficiency or the damage of healthy tissue.

Following recommendations of international medical and radioprotection organizations [AAPM, 1994], [ICRP, 2000] several countries have IVD as a mandatory practice. Until the year 2012, the members in this group were [Patient Safety N5, 2014]: France, Norway, Sweden, Finland, Austria, Denmark and Czech Republic. In others countries as Belgium and the United Kindom consider IVD was considered a good practice. This regulation is expected to spread to other countries in a near future.

Over the last years several publications have shown that MOSFET dosimeters are suitable for clinical applications [Ramani, 1997; Quach, 2000; Dybek, 2005; Cherpak, 2008; Qi, 2009]. Recently, different MOS devices were proposed as sensors for dosimetry [Hardcastle, 2008; Lipovetzky, 2013; Siebel, 2015; Villani, 2016; Garcia-Inza, 2016(1); Faigon 2017]. MOS-based sensors are attractive for dosimetry since they present many advantages in comparison with other dosimeters: small size, mechanical robustness, dose rate independent response, excellent surface response, and adequate dose depth profile for energies in the range of radiotherapy applications [Rosenfeld, 2007]. The dosimetric signal is a voltage signal whose response to ionizing radiation is accumulative with dose and can be read once the exposure has finished, thus wiring is not needed during the irradiation.

However, an accurate dose estimation with MOSFET requires to address three main considerations. First of all, the dosimetric signal is temperature dependent and special care

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