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BOOK OF ABSTRACTS

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NEW FRICKE GEL WITH HIGH SENSITIVITY AND LOW DIFFUSION FOR 3D-MRI DOSIMETRY

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Fricke gel (FG) dosimeters are good candidates for 3D dose assessment in biological materials. Their effective atomic number and density are similar to those of soft tissue. In view of their chemical and morphological characteristics, FG serve as dosimeters and as phantoms at the same time. FG dosimeters are obtained by incorporating an acidic aqueous solution of ferrous ions Fe^{2+} into a gel matrix. After exposure to ionizing radiations ferrous ions are oxided into ferric ions (Fe^{3+}) which modify the relaxation times and, therefore, the 3D spatial distribution of radiation dose could be obtained through MRI. In order to address the limitations of gels based on natural matrices, we have studied FG produced with a matrix of poly-vinyl alcohol (PVA) cross-linked with glutaraldehyde (GTA). The proposed gel contains 10% w/v of PVA and GTA of 1%w/v. A common formulation agarose gel was also prepared and studied for comparison. PVA-GTA gel samples were irradiated using 6 MV x-ray clinical beams. The PVA-GTA FG was read out with magnetic resonance imaging.
MR images were recorded with a 1.5T clinical scanner in order to optimize the acquisition parameters and obtain high contrast between irradiated and non-irradiated samples. The PVA-GTA gels were found to offer good linearity in the range of 0-15 Gy and a stable signal for several hours after irradiation. The sensitivity was about 40% higher compared to gels produced with agarose as gelling agent. The analysis of the Fe^{3+} ions diffusion carried out through a 7T preclinical MRI scanner for small animals showed that the diffusion process is much slower (more than five times) for PVA-GTA gels than for agarose ones. The dosimetric accuracy of the 3D gels was investigated by comparing their response to percentage depth dose and off-axis ratio measurements made with an ionization chamber in a water phantom.

References:
[1] G. Collura, et al., Analysis of response of PVA-GTA Fricke-gel dosimeters with clinical magnetic resonance imaging. *NIMB* **414**, 146-153, (2018).