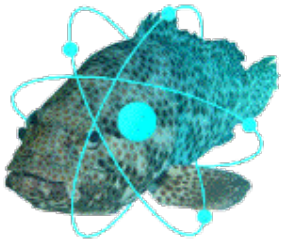

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Dosimetric properties of gel systems upon different irradiation conditions

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Chemical dosimeters represent a promising instrument for treatment plan verification in radiotherapy. To achieve the required dependability in terms of sensitivity, accuracy, precision and temporal stability of measured dose distributions, it necessary to characterize how such parameters might be influenced by varying irradiation characteristics, to mimic the different scenarios that can be encountered in healthcare.
In this study, dependence of typical dosimetric parameters on photon energy and dose rate, as well as post irradiation temporal stability, have been investigated for different dosimeter types, namely Fricke gels and a polymeric gel.
Fricke gel dosimeters, in their most common form, consist of an acidic gelatin-based solution, containing Fe(II) ions and the chelating agent Xylenol Orange (XO). Ionizing radiation promotes the oxidation of ferrous ions to Fe(III), which is then selectively chelated by the XO, forming a complex which exhibits an optical absorbance peak centered at 585 nm and whose intensity correlates quantitatively with absorbed dose.
The family of polymeric gel dosimeters is very broad, but most commonly they are constituted of a combination of monomers and cross-linking agents, typically dissolved in a gelatin matrix. Polymerization of monomers occurs under irradiation, and the growing polymeric chains are then reticulated by the cross-linker. The resulting polymeric network exhibits an increase in optical opacity proportional to the absorbed dose that can be measured in a similar way as is done with Fricke gels.
In this study, the behavior of a Fricke gel with added sucrose was compared to that of PAGAT (PolyAcrylamide Gel And THPC), a polymeric dosimeter composed of the monomer acrylamide (AA) and the cross-linker N,N′-Methylenebisacrylamide (BIS). Following specific preparation procedures, each dosimetric solution was poured into spectrophotometric cuvettes, in order to perform optical analysis on the irradiated samples.
Irradiations have been carried out with a 60Co irradiator and an X-ray source, employing different dose rates and photon energies. Optical analysis was performed with an UV/Vis spectrophotometer acquiring absorbance curves and then extracting absorbance values at wavelengths specific for each of the two dosimeters. The obtained values were then plotted against absorbed dose to yield a calibration plot. Temporal stability evaluation was carried out analyzing irradiated samples at different post-irradiation times, namely 1 hour and 24 hours, to assess the variation of dosimetric properties.

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