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BOOK OF ABSTRACT

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#P113 - Dosimetry to Electron Spin Resonance (ESR) using organic compounds (alanine and ammonium tartrate) for mixed neutron-gamma fields

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Alongside with the development of Neutron Capture Therapy (NCT) and the use of thermal neutrons for radiotherapeutic purposes, many efforts have been devoted to the characterization of the beam in order to optimize therapy procedures. Reliable dose measurements should be able to determine the various (neutrons and photonic) components of the mixed beam usually employed for therapy.

This paper studies the effect of additives such as Boric and Gadolinium nuclei on the sensitivity of neutron organic (alanine and ammonium tartrate) dosimeters analyzed through Electron Spin Resonance (ESR) technique. These dosimeters were exposed to a mixed (neutron-gamma) field mainly composed of thermal neutrons. The choice of ^{10}B and ^{64}Gd as nuclei additives is due to their very high capture cross section for thermal neutrons. Also, after the nuclear reaction with thermal neutrons are emitted particles, which in turn release their energy in the vicinity of the reaction site.

The irradiation with mixed (neutron-gamma) field were performed within the thermal column of the TRIGA reactor, University of Pavia. Dosimeters readout was performed through the Electron Spin Resonance (ESR) spectrometer Bruker ECS106 located at the Laboratory of Dosimetry ESR / TL of the Department of Physics and Chemistry - University of Palermo.

We found that the addition of Gadolinium allows to largely increase the sensitivity of the dosimeters for thermal neutrons. In particular, a low concentration (5% by weight) of gadolinium oxide leads to an improvement of the sensitivity of neutrons more than 10 times. In addition, for this low content of gadolinium the photon tissue equivalence is not heavily reduced. This experimental analyses are compared with computational analyses carried out by means of Monte Carlo simulations performed with the MCNP (Monte Carlo N-Particle) transport code. A good agreement was observed for alanine dosimeters.

#P114 - Agarose and PVA Fricke gel dosimeters exposed to clinical photons beams: Nuclear Magnetic Resonance Relaxometry and Imaging

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Fricke Xylenol Gel (FXG) dosimetric system is based on the radiation induced oxidation of ferrous (Fe^{2+}) to ferric (Fe^{3+}) ions.

The application of Fricke gels for ionizing radiation dosimetry is continuously increasing worldwide due to their many favorable properties. However, one of their shortcomings is that ferrous and ferric ions diffuse in the gel matrix. To maintain the spatial integrity of the dose distribution, Fricke gels must be undergoing measurement within a few hours of their irradiation, so that ferric ions remain close to their point of production. Thus, the spatial integrity of the dose distribution in the Fricke gel is maintained.

The gel matrix also contributes to the oxidation of ferrous ions during irradiation, increasing the chemical yield of ferric ions in aqueous solution and increasing the sensitivity of the dosimeter.

The oxidation of ferrous ions also causes a reduction of the longitudinal nuclear magnetic relaxation time T_1 which can be measured by means of Nuclear Magnetic Resonance Relaxometry (NMR) and Magnetic Resonance Imaging (MRI).

The results presented are related to an experimental investigation conducted on Fricke Gels characterized by gelatinous matrix of Agarose or PVA.

We performed NMR relaxometry investigations which allow for direct measurements of the relaxation times in samples exposed to clinical photon beams. The main dosimetric features of the NMR signal were investigated. The gels were irradiated in the clinical dose range between 0 and 20 Gy. In order to assess the photon sensitivitywe analyzed the dependence of NMR relaxation time on radiation dose with varying ferrous ammonium sulfate content inside FXGs. Furthermore, signal stability was followed for several days after irradiation.

These measurements were preliminary to MRI analysis which can permit 3D dose mapping. In order to optimized the MRI response a systematic study was performed to optimize acquisition sequences and parameters. In particular, we analyzed for inversion recovery sequences the dependence of MRI signal on the repetition time T_R and on the inversion time T_I.

The dose calibration curves are reported and discussed from the point of view of the dosimeter use in clinical radiotherapy. This work has highlighted that the optimization of additives inside gel matrix is fundamental for optimizing photon sensitivity of these