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Abstract's title: Electron Spin Resonance dosimetry using organic compounds (alanine and ammonium tartrate) for mixed neutron-gamma fields

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Abstract

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 Bboric and Ggadolinium nuclei on the sensitivity of neutron organic (alanine and ammonium tartrate) dosimeters analyzed through Electron Spin Resonance (ESR) technique (Marrale, 2014). These dosimeters were exposed to a mixed (neutron-gamma) field mainly composed of thermal neutrons. The choice of 10B and 64Gd 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 (Marrale, 2008).
The irradiation with mixed field (neutron-gamma) were performed within the thermal column of the TRIGA reactor, University of Pavia. Dosimeters readout was performed through the Electron Spin Resonance 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.

M. Marrale et al., Exposure of Gd2O3-alanine and Gd2O3-ammonium tartrate ESR dosimeters to thermal neutrons: experiments and Monte Carlo simulations, Radiation Measurements, volume 43, number 2 (2008).

M. Marrale et al., Neutron ESR dosimetry through ammonium tartrate with low Gd content, Radiation protection dosimetry, volume 159, number 1-4 (2014).