An EPR method for discriminating radiation beams in ammonium tartrate and tooth enamel

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The radiation linear energy transfer (LET), which is the energy released by ionizing radiation per path unit, arouses great scientific interest because the biological damage produced by ionizing radiation in tissues is strictly related to LET. Radiation beams with different LETs will cause different spatial energy distribution and therefore different effects inside matter.

In the last twenty years the EPR spectroscopy has become a valuable dosimetric tool. This technique allows absorbed dose measurements through the detection of free radicals produced by ionizing radiation in organic and/or inorganic compounds.

In this work we have analyzed the possibility of using the acquisition of two components (first harmonic in-phase, FH-0, and second harmonic out-of-phase, SH-90, components with respect to the modulation field) of EPR signal to discriminate the radiation quality. Studies have shown that the second harmonic absorption signal detection out-of-phase of the tooth samples could be promising for the enhancement of the tooth EPR signal [1]. In fact, the tooth EPR signal due to irradiation has large relaxation times and the SH-90 detection is very sensitive to this kind of signals. In particular, in this work we have performed a study of the dependence of the two components of the EPR signal on microwave power in order to achieve information on quality beam and on the effective radiation LET. Actually, for different LET beams the different spatial distributions of the free radicals brings about differences in the relaxation times T_1 and T_2 (longitudinal and transversal, respectively). These differences involve differences in the relative intensities of the two components analyzed. The analyses were carried out on samples of ammonium tartrate which is a promising compound for the measurement of the absorbed ionizing radiation dose, as it shows suitable features, such as high efficiency of radiation-matter energy transfer, and a linear relation between radiation dose [2, 3] and on tooth samples. In particular, ammonium tartrate samples were exposed to 21 MeV protons, ^{60}Co γ-photons and thermal neutrons as radiation beams with different LET. On the other hand, the tooth samples were irradiated to UV and gamma radiation.

References

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