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Abstract's title: Phenol compounds as new materials for Electron Paramagnetic Resonance dosimetry in clinical photon and electron beams

Submitting author: Salvatore Gallo

Affiliation: Department of Physics and Chemistry UniPa, Department of Physics UniMi and INFN Catania Section

Affiliation Address: Viale delle Scienze Edificio 18

Country: Italy

Oral presentation/Poster (Author's request): Poster

Other authors and affiliations: Giuseppina Iacoviello (ARNAS CIVICO Palermo), Salvatore Panzeca (Department of Physics and Chemistry UniPa, and INFN Catania Section), Daniele Dondi (Department of Chemistry UniPV and INFN Pavia Section) Anna Longo (Department of Physics and Chemistry UniPa and INFN Catania Section), Ivan Veronese (Department of Physics UniMi and INFN Milano Section), Maurizio Marrale (Department of Physics and Chemistry UniPa, and INFN Catania Section)

Abstract

In the last decades several research laboratories have shown an increasing interest aimed at extending the applicability of Electron Paramagnetic Resonance (EPR) dosimetry to radiotherapy with different types of radiation beams. EPR is a spectroscopic method for investigating the structure and dynamics of such paramagnetic species. Free radicals are known to be produced when a compound is irradiated with ionizing radiations. The concentration of radiation-induced free radicals is proportional to the energy released inside in the medium and this allows for dosimetric measurements through EPR technique. The use of alanine as a dosimetric material gave the possibility to apply EPR spectroscopy for high-dose standardization and dose control in radiation processing (Marrale 2016).

The EPR dosimetric method has many advantages such as simple and rapid dose evaluation, the readout procedure is non-destructive, linear response of many organic and inorganic compounds. EPR detectors show a behavior that suggest possible applications for various kinds of beams used for radiation therapy. Nowadays, the most widely used organic compound as a dosimeter is the alanine. However, many researches are in progress with the aim at improving sensitivity of EPR dosimetry for doses much smaller than 1 Gy. More sensitive materials than alanine are needed to make the EPR dosimeter competitive with other dosimetry systems.

Our research group has started an investigation of the EPR response of some phenols compounds for possible EPR dosimetric applications suitable features, such as high efficiency of radiation-matter energy transfer and radical stability at room temperature.

Phenols are compounds possessing a benzene ring attached to a OH group. After irradiation the final product is a stable phenoxy radical. The stability of such radical can be improved by adding other alkyl chains which can be attached to the benzene ring.

The phenol octadecyl-3-(3,5-di-tert.butyl-4-hydroxyphenyl)-propionate gave interesting results. Moreover, its high molecular weight, the low volatility and the compatibility with the dosimeter binding material (wax) are advantages with respect to lower molecular weight phenols.

In this work we report the EPR investigation of phenols exposed to clinical photon and electron beams (Gallo, 2016).

The dosimetric features of these EPR dosimeters (dependence on microwave power and modulation amplitude, their response after gamma and electron irradiations, dependence on beam type and energy, the detection limits for both beam typologies, signal stability after irradiation) were investigated and the results are reported.

M. Marrale et al., EPR/alanine dosimetry for two therapeutic proton beams, Nuclear Instruments and Methods B, vol 368 (2016).

Gallo et al., Phenol compounds as new materials for electron spin resonance dosimetry in radiotherapy, Physica Medica, vol 32 (2016).