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CALLIOPE gamma irradiation facility and REX electron beam dosimetric intercalibration

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The Calliope gamma irradiation facility (ENEA Casaccia Research Center) is a pool-type facility, equipped with ^{60}Co gamma source in a large volume (7x6x3.9 m^3) shielded cell, involved in several research fields. At Calliope facility, several dosimetric systems such as Fricke solution, alanine-ESR, Red Perspex, radiochromic, Thermo Luminescent Dosimetry (TLD) and electronic RADFET are used, depending on the absorbed dose range of interest. In particular, by means of the Fricke absolute dosimeter, the relative secondary dosimetric systems are periodically calibrated and used when the Fricke solution is not applicable.

The REX (Removable Electron to X-ray) system (ENEA Frascati Research Center) is based on a pulsed (3.5 μsec pulse length, repetition frequency variable from 5 to 20 Hz) 5 MeV S-band electron linac and a removable head containing an electron to X-ray converter. It is employed in many research fields, from cultural heritage to space component testing, thanks to its customizable radiation beam. The linac extraction terminal and the X-ray converter are enclosed in a lead-shielded chamber (40x40x80 cm^3). The output radiation is routinely characterized by radiochromic films (EBT3, HD-V2), Markus type ionization chamber and Faraday collector. These types of detectors provide information on transverse homogeneity, radiation flux and machine reproducibility, but for an accurate dose estimate a comparison with an absolute dosimeter is necessary. This is especially true for the electron modality, characterized by a very high dose rate (100-400 kGy/h).

One of the most powerful dosimetric techniques is the alanine-ESR dosimetry method based on the detection, by the Electron Spin Resonance (ESR) spectroscopy, of stable free radicals induced by ionizing radiation (e.g. gamma rays or electrons) in the crystalline L-α-alanine amino acid. Thanks to its wide dose range and dose rate and energy independence for energies around few MeV, it is well suited for REX electron beam dosimetric intercalibration.

Dosimetric measurements for the dose rate distribution assessment inside the REX chamber have been performed by means of alanine-ESR dosimeters, calibrated with the absolute Fricke solution at the Calliope facility. In particular, alanine dosimeters were irradiated at the REX facility in different points of the REX chamber, with different irradiation times and at different distances from the electron source. The obtained results will be presented.

Scientific Topic 1

Scientific Topic 2

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Scientific Topic 4

Shielding and dosimetry

Scientific Topic 5

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