Performance of THIN $CaSO_4$:Dy pellets for calibration of a $^{90}Sr+^{90}Y$ source

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Weakly-penetrating beta radiation sources, as $^{90}Sr+^{90}Y$ sources, are commonly utilized in brachytherapy procedures, especially in treatments of superficial lesions. These sources, called applicators, can be plane or concave to better fit the injured surface. The calibration of this kind of source is very difficult because of the great dose gradient near the source surface, and the source dimensions. According to international recommendations, plane sources can be accurately calibrated using an extrapolation chamber. By utilizing an extrapolation chamber it is possible to determine the absorbed dose rate at the source surface or at a reference point. The calibration of concave plaques is more difficult because of the source geometry: plane extrapolation chambers can not be put in contact with the source surface. In this case, the use of calibrated relative dosimeters is recommended, such as thermoluminescent dosimeters, positioned on suitable phantoms [1,2]. The aim of this work was to study the dosimetric characteristics of thin $CaSO_4$:Dy pellets, produced at IPEN/CNEN, SP, Brazil, to verify the possibility of their use to calibrate concave $^{90}Sr+^{90}Y$ applicators.

In this work, thin $CaSO_4$:Dy pellets were utilized. The samples were irradiated using a standard $^{90}Sr+^{90}Y$ source (Amersham Buchler, calibrated at PTB, Germany), a plane and a concave $^{90}Sr + ^{90}Y$ applicators. Prior to each irradiation, the samples were thermally treated. The readout system was a Harshaw Nuclear System, Model 2000A/B. The irradiations with the standard source were performed positioning the samples on a rectangular acrylic phantom, covered by a thin plastic foil; irradiations with the plane applicator were performed in disc-phantoms, with the same thickness. For the calibration of the concave source, the TL samples were positioned on semi-spherical acrylic phantoms.

The main dosimetric characteristics of the thin $CaSO_4$:Dy pellets were determined utilizing the standard source: TL response reproducibility, TL response as a function of radiation dose and as a function of the distance between the source and the samples, and TL response linearity with irradiation time. These results showed the usefulness of the tested pellets for $^{90}Sr+^{90}Y$ dosimetry. At least, calibration curves with the calibrated plane applicator were obtained. Using these curves, it was possible to calibrate a concave $^{90}Sr+^{90}Y$ applicator.

References

[1] C. De Almeida, L. Dewerd, H. Järvinen and C. Soares, Guidelines for the calibration of low energy photon sources and beta-ray brachytherapy sources, SSDL Newsletter, 2000, 43, 4-25.

[2] ICRU – Report 72, Dosimetry of Beta Rays and Low-Energy Photons for Brachytherapy with Sealed Sources**,** *Journal of the ICRU, 2004, 4*.