MEASURING TL AND OSL OF BETA RADIOISOTOPES INSIDE A GLOVE BOX AT A RADIOPHARMACY LABORATORY

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Introduction: The use of beta radiation emitters in therapeutic protocols has increased in the last years. This fact implies in the increase of workers exposed to this kind of radiation. Usually, in these operations workers handle radioactive materials, causing exposure of their extremities, including an inhomogeneous dose distribution in hands and fingers (Mancosu et al, 2010). The thermoluminescence (TL) technique is largely utilized to evaluate beta radiation doses. However, recently, the optical stimulated luminescence (OSL) technique has been shown useful for individual dosimetry (Botter-Jensen et al, 2003), specially using Al_2O_3:C as OSL detectors. The usefulness of this material for beta radiation was presented by Akselrod et al (1999); another study showed that Al_2O_3:C is effective as dosimeter in several different applications (McKeever et al, 2004). Cecatti and Caldas (2006) proposed a TL dosimetric methodology, using $CaSO_4$:Dy pellets, for monitoring of workers exposed to ^{153}Sm at a nuclear medicine service. In the present work, the doses obtained using Al_2O_3:C and $CaSO_4$:Dy detectors, with the OSL and TL techniques, respectively, were compared when both materials were utilized as radiation detectors inside a glove box, in the case of ^{35}S, ^{137}Lu and ^{90}Y radioisotopes at the Radiopharmacy Center of IPEN.

Materials and methods: The OSL measurements were obtained using single nanodot dosimeters of Al_2O_3:C and the MicroStar portable reader, both from Landauer. The detectors were covered with Mylar filters with superficial density between 1.27 $mg.cm^{-2}$ and 7.12 $mg.cm^{-2}$ to avoid their exposure to light and the consequent fading effect. The detectors were optically treated at 26 x 10^3 lux during 12 hours prior each utilization.

Thin thermoluminescent dosimeters (TLDs) of $CaSO_4$:Dy, produced at the Dosimetric Materials Laboratory of IPEN, were utilized. All the TL measurements were obtained using a Harshaw TLD Model 3500. After the irradiations, the pellets were thermally treated at 300ºC during 1 h, for their reutilization.

For the characterization process, the OSL and TL detectors were exposed to ^{90}Sr+^{90}Y, ^{85}Kr and ^{147}Pm standard sources, Isotrak, model BSS2, calibrated at the primary standard laboratory, Physikalisch -Technische Bundesanstalt (PTB), Germany. For the irradiations, the detectors were positioned on a polymethylmethacrylate (PMMA) phantom (120 mm x 120 mm x 15 mm). The TL and OSL measurements were always taken immediately after irradiations.

Results: Reproducibility studies of TL and OSL responses were realized using the pellets and the beta radiation of ^{90}Sr+^{90}Y. The lower detection limits were determined for both kinds of pellets.

The dose-response curves were obtained for the Al_2O_3:C and $CaSO_4$:Dy pellets for ^{90}Sr+^{90}Y, between 0.5mGy and 10mGy; the results agree with those from other authors (Yukihara and McKeever, 2008). The energy dependence of the response of both TL and OSL detectors was obtained using the three sources of the BSS2 system.

These dosimeters were applied at the Radiopharmacy Laboratory. The phantom with the detectors was positioned inside a glove box, in front of the beta source of ^{35}S, ^{177}Lu and ^{90}Y, at a distance of 10 cm.

Using the dose-response and the energy dependence curves, the absorbed doses were determined for the cases of TL and OSL detectors exposed to the sources of ^{35}S, ^{177}Lu and ^{90}Y.

Conclusions: The results obtained for the TL and OSL detectors showed agreement within about 5.0%, presenting the possibility of their application for the monitoring of extremities of workers exposed to beta radiation at nuclear medicine services.

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