APPLICATION OF THE OSL TECHNIQUE FOR DETERMINATION OF THE USEFUL CALIBRATION DISTANCE RANGES FOR BETA RADIATION DETECTORS

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1. Introduction

The dose rate monitors have to be calibrated to verify their behavior when exposed to standard radiation beams [1], and in the case of beta-gamma radiation detectors, they have to be initially calibrated in standard gamma beams and then in standard beta radiation beams at the specific conditions provided in their calibration certificates. However, there are several kinds of monitors that cannot be calibrated at these reference distances, because they are not adequate in relation to the monitor scales. Optically stimulated luminescence (OSL) detectors, as for example Al2O3:C, present good performance when exposed to beta radiation [2,3], and therefore, they were utilized in this study.

2. Objective

The objective of this work was to determine the useful source-detector distance ranges for the calibration of dose rate monitors, presenting importance for the Calibration Laboratory, because several different kinds of beta-gamma radiation detectors are calibrated every year.

3. Materials and Methods

- OSL commercial detectors:
  - nanoDot of Al2O3:C, Landauer
- Optical treatment: 26x10^3 lux (during 24 h) for reutilization
- OSL reader:
  - microStar OSL portable reader, Landauer
- Characterization tests:
  - OSL detectors fixed on a PMMA support
- OSL measurements taken after irradiation

4. Results

1. Reproducibility

- Five series of irradiation, measurement and optical treatment
- Absorbed dose = 10 mGy (90Sr+90Y, BSS2)
- Reproducibility = 3.6%

2. Dose-Response Curve

- Interval dose: 1 mGy to 1 Gy
- Source: 90Sr+90Y (BSS1)
- Source-detector distance = 11 cm
- Maximum standard deviation = 6.9%

3. Energy Dependence Study

- Maximum standard deviation = 4.9%  

4. Variation of the OSL Response with the Source-Detector Distance

- Source: 90Sr+90Y (BSS1)
- Interval distances: from 10 cm to 55 cm
- Maximum standard deviation = 5.2%

5. Conclusions

The characterization tests showed the efficiency of nanoDot detectors in standard beta radiation fields, and a strong dependence of the nanoDot OSL response with the beta radiation energy. The results of this study on the variation of the OSL response with the source-detector distance showed that the OSL response follows the inverse square law. The conclusions were important for the Calibration Laboratory, because the calibration of several different models and kinds of monitors will be possible determining the absorbed dose rates at any distance among those tested.

References


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