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LIGHT INDUCED FADING OF THE OSL RESPONSE OF Al_2O_3:C DETECTORS

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ABSTRACT

The optically stimulated luminescence technique (OSL) has been proposed for the determination of personal and environmental radiation absorbed doses. Al_2O_3: C has become a material of successful personal OSL dosimeters due to its high sensibility; it emits a large amount of stimulated luminescence per unit of radiation dose absorbed. One potential limitation of the utilization of this material, however, is its sensitivity to light. It presents a strong light induced fading of the OSL signal in Al_2O_3: C. The objective of this paper was to study the light induced fading of the OSL signal of Al_2O_3: C. The experimental results indicate that the light induced fading of Al_2O_3: C is relatively strong, when exposed to fluorescent light.

1. INTRODUCTION

The optically stimulated luminescence technique (OSL) has become a popular procedure for the determination of environmental radiation doses absorbed by archaeological and geological materials [1, 2]. However, various authors have reported the use of OSL as a personal dosimetry technique [1, 2, 3].

The OSL technique presents several advantages in relation to the thermoluminescent technique. It is normally measured at or near room temperature, thus this fact avoids problems associated with the thermal quenching luminescence. The OSL signal can be measured many times on the same sample [4]. It is a non-destructive technique.

The main reason for relatively few applications of the OSL technique in personal dosimetry has been the lack of a suitable luminescent material with high radiation sensitivity, a high optical stimulation efficiency and good fading characteristics [3].

Al_2O_3: C has become a material of choice for OSL dosimetry; therefore it has excellent dosimetric properties as high sensitivity and low effective atomic number [5,6], but this material has limitations that still needs to be understood. The fading is among the most important dosimetric characteristics. The existence of light-induced fading in Al_2O_3: C due to accidental exposure to light may result in loss of dose information [7].

The objective of this paper was to study the light induced fading of the OSL signal of Al_2O_3: C exposed to two different light sources: 260 lux and 26,000 lux of fluorescent light.

2. MATERIALS AND METHODS

The commercially available OSL Inligth dot dosimeters of crystal α-Al_2O_3: C from Landauer, USA, were employed in this study. These detectors were initially exposed to 0.3 mGy up to 15 mGy of beta radiation (^{90}Sr + ^{90}Y) of the secondary standard system Buchler GmbH & Co, Germany, of the Calibration Laboratory of IPEN. It was calibrated at the primary standard laboratory Physikalisch - Technische Bundesanstalt (PTB), Germany.

The study was realized at the Calibration Laboratory of IPEN. Immediately after irradiation, two groups of detectors were exposed to 260 lux from the laboratory environmental fluorescent light and to 26,000 lux of fluorescent light inside a closed box. In both situations the exposure time was varied from 0.5 min to 30 min.

The microStar OSL reader with software, Landauer, was utilized to obtain the measurements of OSL dot dosimeters of α-Al_2O_3:C. The measurements were realized in seconds.

3. RESULTS AND DISCUSSION

The light induced fading of the OSL response in α-Al_2O_3:C detectors as a function of exposure time to 260 lux and to 26,000 lux of fluorescent light is presented in Figures 1 and 2, respectively, for different beta absorbed doses.

The fading of the OSL response of the Al_2O_3:C detectors previously irradiated with different doses of beta radiation (0.3 mGy to 10 mGy) and subsequently exposed to environmental fluorescent light (260 lux) varied between 17% and 23% in the first 5 minutes. After 30 min of light exposure, the fading of the OSL response varied between 50% and 52%.

In the case of the α-Al_2O_3:C detectors exposed to 26,000 lux of fluorescent light inside the box, the OSL fading was 73% to 90% after the first 5 minutes of exposure. After 30 minutes of exposure to fluorescent light, the Al_2O_3:C detector response was almost null. The tendency of the OSL response of this detector is null with a longer time exposure.

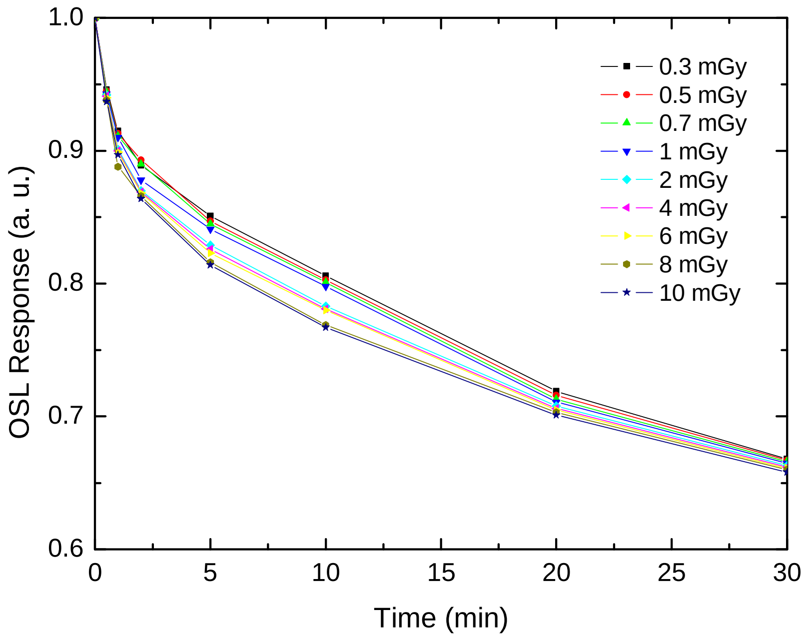

Figure 1. Light induced fading of OSL response of Al_2O_3: C detector as a function of exposure time to 260 lux of fluorescent light after irradiation with beta radiation (0.3 mGy – 10 mGy).

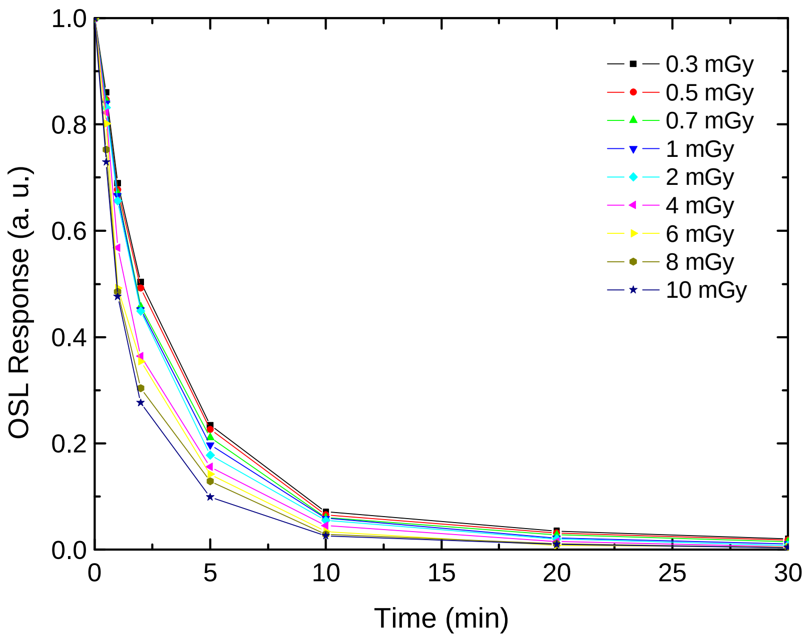

Figure 2. Light induced fading of OSL response in Al_2O_3: C detectors as a function of exposure time to 26,000 lux of fluorescent light after irradiation with beta radiation (0.3 mGy – 10 mGy).

4. CONCLUSION

The experimental results indicate that the light induced fading of Al_2O_3:C is relatively strong when exposed to fluorescent light. Due to the high sensitivity to light of the Al_2O_3:C detectors, they present excellent dosimetric characteristics for personnel dosimetry. The detectors shall preferentially be completely shielded and manipulated in dark rooms to avoid the fading of OSL response. The source of 26,000 lux of fluorescent light inside the box showed to be an excellent and cheap choice to allow re-utilization of the Al_2O_3:C detectors.

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