Purpose: To investigate the effect of bleaching wavelengths on the regeneration of optically stimulated luminescence (OSL) signals in Al$_2$O$_3$:C nanoDot dosimeters pre-exposed to high doses. Regeneration is the increase in the OSL signal during storage of a bleached nanoDot that was previously pre-exposed to a high dose. This phenomenon affects the accuracy of a calibration protocol proposed by Jursinic 2010 (Med. Phys. 37:102) in which pre-exposure of nanoDots to a high-dose was used to minimize changes in the sensitivity of the detector as a function of accumulated dose.

Methods: Al$_2$O$_3$:C OSLDs of the type nanoDot were used throughout this study. Readout was performed using the microStar reader. Bleaching of the OSLDs was performed with four 26 W fluorescent light bulbs in two modes: (i) directly under the lamps; and (ii) with the aid of a long-pass optical filter placed over the nanoDots, partially blocking wavelengths below 495 nm. Eighteen nanoDots were pre-exposed to 1 kGy dose. Then the pre-exposed nanoDots were bleached in two sets of 9 to very low residual OSL signals using bleaching modes (i) and (ii) for 12 h and 45 h, respectively. The nanoDots were then stored in dark and readout after various time intervals to monitor the regeneration of the OSL signal.

Results: We fitted the regeneration of the OSL signal using a saturation function and obtained rise-time values of 563 h and 630 h, for bleaching modes (i) and (ii), respectively. At the saturation level, the equivalent doses were about 1.18 Gy and 0.38 Gy for modes (i) and (ii), respectively.

Conclusions: The regeneration rates of nanoDot OSLDs pre-exposed to high doses depend on the bleaching light wavelength used to reset the detectors. A bleaching source that has a low component of wavelengths below 495 nm can minimize the regeneration of the OSL signal.

Funding Support, Disclosures, and Conflict of Interest:

Natural Sciences and Engineering Research Council of Canada