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IND-P-50

TL, OSL and TSEE of Obsidian Silicate samples, exposed to a ^{60}Co source

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The Obsidian is a natural material of the silicate family; it is known as a natural glass. Different materials (for example Opal, Jasper and Amethyst) were already investigated in relation to their response after exposure to radiation sources. The luminescence techniques as thermoluminescence (TL), optically stimulated luminescence (OSL) and thermally stimulated exoelectron emission (TSEE) are commonly employed to evaluate the signal from the irradiated samples after stimulation by heat or light. This work has the objective of studying the TL, OSL and TSEE responses of Italian Obsidian samples exposed to high-doses of a ^{60}Co source.

From a natural stone of Obsidian, pellets were manufactured in a proportion of 2:1 of powdered samples of Obsidian:Teflon, and dimensions of 6.0 mm in diameter and 0.8 mm in thickness. These samples were irradiated at IPEN, using a Gamma-Cell 220 System (^{60}Co source). The TL and OSL signals were evaluated using the TL/OSL Risø reader system, model TL/OSL-DA-20. The TSEE response was verified using a homemade reader system developed at the Calibration Laboratory (LCI), at IPEN, with a proportional detector. After the measurements, the pellets were thermally treated at 400°C during 1 h, for reutilization.

Powdered Obsidian was initially investigated in relation to its structure, morphology and chemical composition, by means of the techniques of X-ray diffraction (XRD), scanning electronic microscopy (SEM) and energy-dispersive X-ray spectroscopy (EDX), respectively. These results showed that the silicate belongs to the tetragonal crystal system; it presents a predominant presence of SiO_2 and impurities, and irregular morphology. The dosimetric characteristics of Obsidian+Teflon pellets were evaluated in terms of their response to absorbed doses in an interval of 100 Gy to 10 kGy (^{60}Co). The TL glow curve revealed a dosimetric peak at the temperature of 220°C, and the TSEE emission curve showed a peak at 170 °C. The reproducibility of response was: 2.9% (TL), 3.1% (OSL) and 4.0% (TSEE), for an absorbed dose of 1 kGy. The response in function of the absorbed dose was verified presenting a supralinear behavior with tendency to saturation (from 100 Gy to 10 kGy) for TL, a sublinear behavior with tendency to saturation for OSL, and an increasing behavior in the whole studied range of absorbed dose (TSEE).

The parameters studied and the results obtained for the pellets of Obsidian+Teflon, as TL and TSEE emission curves and OSL decay curves and reproducibility of response, showed that these samples present good dosimetric conditions for high-dose dosimetry. However, the inexistence of a linear response in function of the absorbed dose (just for TSEE), does not enable the use of this material as a dosimeter. In the cases of TL and OSL, the pellets may be used in high-dose dosimetry.

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