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Applying the TSEE technique to Spectrolite and Opal pellets irradiated with high doses of gamma radiation

Patrícia Antonio[1], Linda Caldas[1]
[1]Instituto de Pesquisas Energéticas e Nucleares, Comissão Nacional de Energia Nuclear, IPEN/CNEN-SP, São Paulo, Brazil

Thermally stimulated exoelectron emission (TSEE) consists in a technique in which the emission of the low energetic electrons occurs mainly from the superficial region of the material; thus, it is well employed in studies with radiation sources of low penetrating power (alpha and beta rays). This phenomenon was already used for solid state dosimetry, with commercial and natural materials, as gemstones. The use of TSEE is present in literature for gamma radiation (high penetrating power), in cases as for Topaz, Actinolite and Tremolite. The purpose of this work was to investigate the dosimetric characteristics of the Spectrolite+Teflon and Opal+Teflon pellets (already analysed in relation to the TL and OSL luminescent techniques in a previous study), by means of the TSEE phenomenon, exposing the samples to high doses of gamma radiation.

The Spectrolite+Teflon and Opal+Teflon pellets were irradiated using a ^{60}Co source, Gamma-Cell 220 System, from the Radiation Center Technology, at IPEN, and the experiments were performed using a dose interval of 5 Gy to 10 kGy. A homemade reader system, projected and developed at the Calibration Laboratory of IPEN, was used to measure the TSEE response, with a gas-flow proportional counter. The measurement parameters were: continuous flow of gas and associated electronics, maximum temperature of heating of 350ºC, and a heating rate of 5ºC/s. All the pellets were submitted to the thermally treatment of 400ºC during 1 h, after their response analyses, for their reuse.

The dosimetric properties of both materials were verified by means of the following characterization tests: TSEE emission curves, reproducibility (absorbed dose of 1 kGy) and dose-response curves (varying the dose from 5 Gy to 10 kGy). The TSEE emission curve showed that the Spectrolite samples have only one dosimetric peak about 170ºC, and the Opal, also only one peak, about 150ºC. The series of irradiation, measurement and thermal treatment revealed a reproducibility of response of 5.2% for the Spectrolite+Teflon pellets and 4.1% for the Opal+Teflon pellets. The variation of the TSEE response in function of the absorbed dose exhibited an increasing behavior for both materials.

The results obtained for the Spectrolite and Opal pellets allow observing that they present a good reproducibility of response when irradiated with high doses of a ^{60}Co source. The TSEE emission curves showed very well defined dosimetric peaks for both materials. The dose-response curves for the Spectrolite and Opal pellets presented an increasing response behavior in function of dose, but no linear region.

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