Influence of the thermal treatment on the PTTL and PTOSL signals from different natural materials

Patrícia L. Antonio and Linda V. E. Caldas

Instituto de Pesquisas Energéticas e Nucleares, Comissão Nacional de Energia Nuclear, IPEN/CNEN-SP
Av. Prof. Lineu Prestes, 2242, 05508-000, São Paulo, SP, Brazil

The phototransferred luminescence phenomenon consists in the displacement of the electrons from deeper traps to the shallower traps, which occurs when a phosphor material (insulator or semiconductor) is illuminated [1]. The phototransferred thermoluminescence (PTTL) and the phototransferred optically stimulated luminescence (PTOSL) are two techniques based on this phenomenon, and it is common to observe, in these cases, an increase in the intensity of the luminescent glow peaks. This fact can be observed when a material is irradiated, thermally treated, exposed to light and then its signal is evaluated.

The objective of this work is to investigate if three kinds of natural materials (Spectrolite, Opal and Obsidian, from the group of silicates) present PTTL and PTOSL signals and to study the influence of the thermal treatment between the irradiation (^{60}Co source) and the exposure to the light procedures on these signals.

Pellets (6.0 mm of diameter and 0.2 mm of thickness) of the powdered materials of Spectrolite and Opal (already studied in relation to the TL and OSL signals in high-doses of a ^{60}Co source [2,3]), and Obsidian, mixed to powdered Teflon were used. In this work, the three kinds of materials were irradiated with an absorbed dose of 1 kGy of a ^{60}Co source. The pellets were thermally treated with two different treatments: 200°C/15 min and 280°C/15 min (Spectrolite), 170°C/15 min and 200°C/15 min (Opal), and 210°C/15 min and 280°C/15 min (Obsidian). After these treatments, the pellets were exposed to the ultraviolet light of a short-arc mercury lamp during 30 min, and then, their PTTL and PTOSL responses were evaluated using the TL/OSL reader system Risø, model TL/OSL-DA-20. The measurements taken showed that the best responses appeared after the following treatments: 200°C/15 min for Spectrolite, 170°C/15 min for Opal and 210°C/15 min for Obsidian. Furthermore, the PTTL and PTOSL responses were investigated in function of the wavelength variation (from 230 nm to 410 nm, in steps of 20 nm) and the exposure time (15 min, 30 min, 45 min and 60 min). The results obtained in both studies were, respectively: 250 nm and 30 min for PTTL and PTOSL (Spectrolite and Obsidian) and 290 nm and 30 min for PTTL and 310 nm and 60 min for PTOSL (Opal). Thus, it was possible to stablish the most adequate thermal treatment between irradiation and UV exposure, and also to observe the presence of the PTTL and PTOSL signals in the natural materials. This fact leads to the possibility for a continuation of the study with these samples in order to analyze the dosimetric characteristics from their phototransfer luminescence.

Keywords: silicates, UV radiation, ^{60}Co

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