

TL and OSL dosimetric properties of Opal gemstone for gamma radiation dosimetry

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Some gemstones (silicates) have already been investigated for application in high-dose dosimetry (amethyst, topaz and jasper), but most of them present some limitation (for instance, fading). The Australian national gemstone Opal is basically composed of silica and water, and can be mainly of four types: white, black, fire and water opal. Its main characteristic is the opalescence, an iridescence where the light is scattered causing a visual effect of rainbow, that varies according to the angle in which the gemstone is observed.

For this study, Teflon powder was added to the powdered Opal stone in proportions of 1:1, 1:2 e 2:1, and round sintered pellets were manufactured with dimensions of 6.0 mm of diameter and 0.8 mm of thickness.

The purpose of this work was to verify the possibility of its application in high-dose gamma dosimetry, using the thermoluminescence (TL) and optically stimulated luminescence (OSL) techniques. The Opal+Teflon pellets were irradiated at IPEN, using a Gamma-Cell 220 System (⁶⁰Co source). The TL and OSL evaluation of this material was through measurements taken at the Calibration Laboratory (IPEN), using a TL/OSL reader system Risø, model TL/OSL-DA-20.

In order to verify the physical and chemical characterization of Opal, X-ray diffraction, scanning electronic microscopy and energy-dispersive X-ray spectroscopy techniques were utilized.

The dosimetric properties of the pellets were verified by means of the following characterization tests: TL glow curve, OSL decay curve, reproducibility of the response, dose-response curve and lower detection limit. All the performed tests presented results compatible with those necessary for a material to be considered as an adequate gamma radiation detector.