Dosimetric characterization by thermoluminescence of dental zirconia based materials

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The need to evaluate the dose threshold for biological effects, coming from natural or human origin radiation sources, has led to the development of the area of dosimetry. Accidental dosimetry deals with the quantification of the dose absorbed after an accident. Thermoluminescence (TL) stands as one of its most valuable techniques. An appropriate sample for this purpose would be in the immediate vicinity of human. Materials which meet this requirement are restorative dentistry materials that present the advantage that sampling does not require irreversible surgery.

The present study aims on establishing the materials used in restorative dentistry as objects of personal accidental dosimetry, but also to establish luminescence techniques as innovative methods for the discrimination between materials with different stabilizers. The study is performed on three materials with different composition. All of them are monolithic zirconia, but they differ in the amount of stabilizer in their synthesis, which is used to maintain high toughness. Following are presented the applied steps:

1st step: preparation of specimens

2nd step: structural characterization studies in all specimens

3rd step: dosimetric study with TL measurements.

The aim of the TL measurements is to check the luminescence stability of the materials after successive cycles of irradiation and heating, the dose response and the lower detectable limit, since these are the most important aspects that should be studied for a potential personal accidental dosimeter.

The preliminary study presents promising results and comparable to existing studies on similar materials [1,2]. They aim to the establishment of dental restorative materials as personal passive/accidental dosimeters. The goal of this general project is to study all restorative dental materials in the same direction, for a complete data base.

[1] I.K. Sfampa et al., Appl. Radiat. Isot. 157, 109024 (2020).

[2] I.K. Sfampa et al., Radiat. Meas. 125, 7 (2019).