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DEVELOPMENT OF AN INTEGRATED SYSTEM FOR THERMOLUMINESCENCE AND RADIOLUMINESCENCE MEASUREMENTS

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Introduction: Thermoluminescence (TL) and radioluminescence (RL) have been used extensively to evaluate materials for dosimetry application. TL is the light emitted by some crystals when heated, being a thermally stimulated emission of the energy that was previously stored in the material during irradiation [1]. Likewise, RL corresponds to the luminescence emitted by a material under exposure to ionizing radiation [2]. Among the energy levels of a crystal, some trapping levels are not influenced by RL, whereas all trapping levels are more significantly influenced by TL. Therefore, through the analysis of these luminescence curves obtained from RL and TL, we can obtain extensive information about the trapping levels rather than the case of individual treatment [3]. In this study, an integrated TL/RL measurement device will be developed to analyze accurately the luminescence mechanism of materials.

Material and method: The TL/RL involves three main components: heating, ionizing radiation, and light collection systems. To heat the samples a ferritic iron-chromium-aluminum alloy (FeCrAl alloy) is being designed to be the heating element. Temperature control will be done using a universal phase angle controller combined with a microcontroller system that controls ramp temperatures (*e.g.* 1 - 10ºC/s), which can reach temperatures up to 500º C using a K-type thermocouple. To irradiate the samples, a X-ray tube (Moxtek 50kV Cabled), common to both measurements (TL/RL), is powered, controlled, and monitored by a standard controller (FTC-200 X-ray Source Controller). The light collection system will consist of a Photomultiplier Tube (PMT, Hamamatsu H10493-012:HA) that amplifies the intensity of light emitted in the luminescence, whose wavelength is between 185 nm to 850 nm. In addition, a miniature fiber optic spectrometer (Ocean Optics, FLAME-S-XR1-ES), range 200-1050 nm, and the 1000 um fiber optic (QP1000-2-UV-VIS), 2 m, supplied with interchangeable round SMA 200 um (INTSMA-200) will be used to identify the wavelength of the emitted light. A shielding box was made in which the TL/RL measuring device will be inserted. This shielding box is being made with lead and stainless steel panels, and the X-ray source will only work under certain conditions.

Results: Figure 1 shows a schematic view of the whole system and arrangement of the equipment previously described. A wheel of ten samples storage moved by servo motor drive has been designed, that will provide an optimized time setup between sample changes.

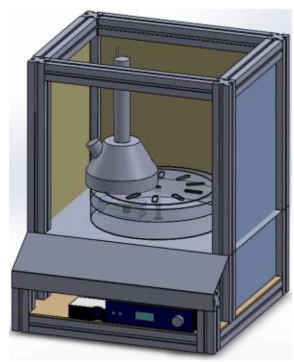

Figure 1: Projection of the integrated TL/RL measurement system.

Conclusions: In this study, an integrated TL/RL measurement system has been developed. RL will provide insight into the nature of the luminescence centers and thus to complement TL in the development of new luminescent dosimeters.

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References:

1. S. W. S. Mckeever, *Thermoluminescence of Solids.* Cambridge: Cambridge University Press, 1985.
2. L. V. S. França, L. C. Oliveira, and O. Baffa *Measurement. Letters* **134**, 492-499 (2019).
3. C-Y. Park, et al., *Journal of Radiation Protection and Research. Letters* **43**, 160-169 (2018).