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UVC-IRRADIATED ALEXANDRITE PELLETS FOR APPLICATIONS IN THE DOSIMETRY FIELD

NUNES, M.C.S.[1], LIMA L.S.[2], YOSHIMURA, E.M.[2], and TRINDADE, N.M.[1,2]

[1]Department of Physics, Federal Institute of Education, Science and Technology of São Paulo, São Paulo, SP 01109-010, Brazil, matheuscavalcanti68@gmail.com
[2] Institute of Physics, University of São Paulo, São Paulo, SP 05508-090, Brazil

Introduction: The increasing use of UV radiation from artificial sources can significantly contribute to the risks of UV overexposure and it is the main factor that causes skin cancers, erythema, opacification of the lens and inflammation of the eyes. Due to this a search for new materials and practical methods for UV detection and dosimetry becomes important. Recently we have studied some luminescent properties of Alexandrite mineral ($BeAl_2O_4:Cr^{3+}$) using optically stimulated luminescence (OSL). We have concluded that this material, in a composite with an organic matrix, the OSL sinal presents a linear increase with absorbed dose of beta radiation. Within this context, the potential of natural alexandrite as a UV dosimeter has also been investgated.

Material and method: The alexandrite-polymer composites were produced using a sample of natural Brazilian alexandrite. This natural sample was manually pulverized, and the obtained powder was sieved resulting in grains smaller than 0.35 mm. This powder was then mixed with an organic matrix based on a fluorinated polymer. In this work, 5 pellets with 20% alexandrite were used.

Beta irradiation was carried out at room temperature using the built-in $^{90}Sr/^{90}Y$ beta source of the OSL reader (dose rate of 10 mGy/s) within an exposure time of 20 to 300s (dose range of 0.2 to 5.0 Gy). Exposure to UVC was performed at different time intervals, from 20 to 300s, with the sample being placed in front of the lamp at a distance of about 30 cm. The ultraviolet lighting system used was the Boitton lamp, model BOIT-LUB01, in the spectrum of the UVC range (254 nm) with 6W of power. The parameters of the OSL curves were analyzed by the OriginLab software and by the R language with the R Studio software.

Results: In figure 1, it is possible to notice that for beta exposure (triangles) the pellets present a linear response as a function of increasing dose, but for UVC exposure (circles), despite also presenting linearity between 20 and 60s, a saturation curve was obtained for longer exposure times, and the curve can be characterized with an exponential fit.

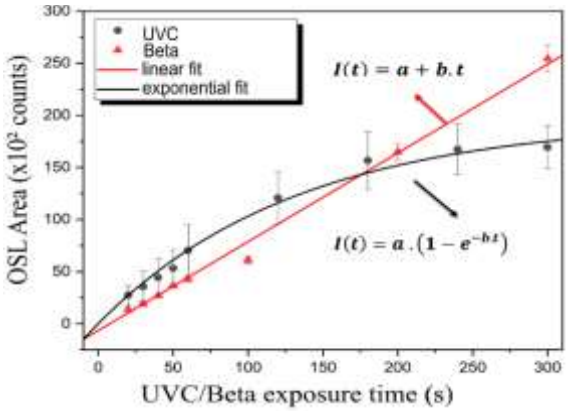

Figure 1: Response dose of alexandrite pellets under exposure to beta and UV radiation.

Deconvolutions of the OSL curves for Beta and UVC were also performed. Analysis of the curve components showed that for exposure to beta and UVC, the pellets have 3 components, being a fast, a medium and a slow. These adjustments demonstrate that alexandrite, regardless of the irradiation time, can have at least 3 luminescence centers.

Conclusions: In general, the pellets show sensitivity to the two types of radiation studied. It was possible to notice that the shape of the OSL curves was independent of the Beta and UVC dose. With the preliminary results of the comparison between beta and UVC, it was possible to conclude that the OSL components are linked to the more intense thermoluminescent peaks (dosimetric) of alexandrite[1].

References:

1. M.C.S. NUNES et al. *Journal of Luminescence*, v. 226, n. May, p. 6–11, 2020.