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Abstract: Aerospace crews are exposed to several phenomena that are harmful to living organisms. One of these is cosmic radiation. For the safety of the personnel, it is important to know the intensity of ionizing radiation at different altitudes above the Earth to calculate the accepted dose. To detect cosmic radiation, an optoelectronic detector has been designed. It includes a scintillation crystal, a semiconductor photomultiplier, and an electronic circuit responsible for signal analysis. The silicon photomultiplier (SiPM) is a detector consisting of an array of avalanche photodiodes. Its sensitivity is sufficient to detect single photon events, and the bias voltage is lower than in a classical photomultiplier, increasing its application potential. After the design and execution, the detection system was tested. During the experiment, cosmic radiation was simulated using two natural radioactive sources of different activity levels. The experimental setup used several different scintillation crystals, including NaI(Tl), CsI(Tl), and LYSO(Ce). The measurements were based on checking the count rates of the system under normal environmental conditions and in the presence of an ionizing radiation source. The addition of the radiation source resulted in an increase in the count frequency by several times. Obtained results confirmed the potential of detecting ionizing radiation with an optoelectronic detector. Improvements to the design are still in progress. Ultimately, the detector will be able to determine the energy of the detected particles and the absorbed radiation dose. It is also planned to refine the electronic systems to increase mobility and reduce the size of the device.

ID_118

Title of the abstract: Development of Ce3+-doped magnesium borate glass-ceramic for optically stimulated luminescence dosimetry

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Abstract: Among several new optically stimulated luminescence (OSL) materials that have been investigated, magnesium borate has been attracting attention as a host material for dosimetry-based techniques, such as OSL and thermoluminescence (TL), for reasons such as effective atomic number similar to water and tissues, and the possibility to produce a neutron sensitive material, by controlling the host content of 10B isotope. More specifically, Ce3+-doped MgB4O7 has also been proposed as a potential OSL material for 2D dosimetry, because of its fast luminescence. Although the literature on sintered MgB4O7:Ce is abundant, the objective of this work is to produce this material (Ce3+-doped magnesium borate) in the form of glass-ceramic, which has many advantages, such as good formability in complex shapes, low cost, fast mass production and denser than conventional powder sintered materials, and might lead to dosimetric improvement. The Ce3+-doped magnesium borate was produced following the composition of 55B2O3 – 45MgO – 0.3 CeO2 (mol), which was normalized thereafter to obtain 100%. After being weighted and mixed uniformly, the mixture was melted at ~1250 °C for 1 h, and the final glass was obtained by splat cooling between two steel plates. Both the powder of ~60 µm and pellets of 5x5 mm2 and 0.6 mm width were obtained for further investigation, which began with a structural analysis of the material. DSC measurements were performed to define the thermal treatments for crystallization. Five temperatures were chosen symmetrically between the glass transition range, 630 °C, and the DSC crystallization peak temperature of 814 °C. Both monoliths and powder were treated at these temperatures for 3 h, and XRD measurements were carried on the crystallized powder to verify if the samples underwent crystallization or not. The samples treated at the first two temperatures, 630 °C and 676 °C remained glassy, whereas the samples treated at 722 °C, 768 °C and 814 °C showed XRD peaks with the same predominant pattern as the reference material for triclinic Mg2BO5 (COD 96-200-3244). A Risø TL/OSL reader, with an integrated 90Sr/90Y beta source (0.08 Gy/s, in 2023) was used for both reading and irradiating the samples. The monoliths treated under all conditions underwent a preliminary dosimetric characterization; first, after being irradiated with 0.8 Gy a TL glow curve was obtained to verify the peak positions and their thermal stability. Both 630 °C and 676 °C treated samples showed one wide peak at around 80 °C, which is related to shallow electron traps, while samples treated with 722 °C, 768 °C and 814 °C showed two main peaks, one at 100 °C, and the second, 220 °C, due to shallow and deep electron traps, respectively. Accounting for the fading of the shallow electron traps, a high reproducibility, from 0.4% to 4.2% standard deviation, was observed in the OSL measurements. The full dosimetric characterization is expected to be completed before the conference.

ID_119

Title of the abstract: Radionuclide radiation recognition using two dosimetric detectors of different Z_eff

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Abstract: If the effective atomic number Z eff of the dosimetric detector differs from the Z eff of the human body, then it will register the absorbed dose value of the γ-radiation that differs from the dose got by the human body or the tissue equivalent detector at any energy other than that at which it was calibrated. This feature of the non-tissue equivalent detector is usually considered as a disadvantage but it can be used for emergency dosimetry when it is necessary not only to evaluate the absorbed dose, but also to identify the type of source of unknown radiation as soon as possible, e.g. if the terrorists use some kind of radiation dispersal device which got a common media term a “dirty bomb”. The problem of γ-radiation distinguishing of radioisotopes which could most probably be used in such a case and the feasibility of solving it using the so-called energy-selective tandem dosimeter with two detectors of different Z eff is considered in this work comprehensively by studying the energy dependence of dosimetric sensitivity of different storage phosphors, theoretical analysis of the measured dose values and their processing to distinguish from their difference the most hazardous isotopes from the point of view of external irradiation, and finally by experimental proof of this recognition concept. We used two dosimetric detectors in a tandem dosimeter for the experiments. The first detector of low, close to tissue-equivalent, Z eff was a BeO based ceramics (Z eff = 7.1) and the second one was a high Z eff crystalline detector based on the