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SHORT COMMUNICATION

PREPARATION OF $CaSO_4$:Dy TL SINGLE CRYSTALS *

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A new preparation method of TL dosimetric single crystals of $CaSO_4$:Dy for physical studies is described.

In recent times, $CaSO_4$:Dy thermoluminescent (TL) phosphor has been increasingly in use for radiaton monitoring due its high sensitivity and ease of preparation The method used for the preparation of the rare-earth doped $CaSO_4$:Dy phosphor depends mainly in obtaining a solution of calcium sulphate and the rare earth oxide in excess of concentrated sulfuric acid [1]. This solution is then evaporated slowly to dryness in PVC fume hood. The resulting sample is in the form of microcrystals. This method showed two great inconveniences: corrosion and environmental pollution.

In this work we describe a new preparation method for TL dosimetric single crystals of $CaSO_4$:Dy of optical quality for dosimetric and physical studies. The method developed eliminates the problem of environment contamination with H_2SO_4 vapour.

Single crystals of $CaSO_4$:Dy were grown by the slow evaporation method from a solution of $CaSO_4 + Dy_2O_3$ in excess of concentrated H_2SO_4. A sealed system was utilized with constant nitrogen gas flow as the carrier vapour; a condenser system for the acid vapour and a couple of flasks with NaOH solution to capture and neutralize the condensed acid. An insomantle was used with a Variac so that the temperature could be controlled as desired. The temperature was monitored using a chromel–alumel termocouple [2]. By this method crystallization can be controlled by varying the temperature and gas flow rate [3]. Single crystals with dimensions of $5.5 \times 3.5 \times 1$ mm were obtained and analysed by X-ray diffraction method (Laue) that confirmed the mono-crystallinity of the samples. A photograph of a typical sample is shown in fig. 1.

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Fig. 1. Macrography of a typical $CaSO_4$: Dy sample, amplification 15×.

Dosimetric characteristics of these crystals were investigated using TL technique. The integrated TL outputs compared for a gamma irradiation of 100 mR shows that the maximum variation in gamma ray sensitivity from sample to sample is around 7%. The minimum detectable exposure is 1 mR (^{60}Co) per 10 mg of sample weight due to crystal transparence. This sensitivity is around a factor of 3 better than $CaSO_4$: Dy TL powder. Dopant concentrations varying from 0.05 to 0.4% by weight in $CaSO_4$ were prepared and the gamma ray sensitivity was investigated. The TL output increases until 0.1% then it gradually falls off with an increase in the dopant concentration. This behaviour follows the concentration quenching law and determines the optimum Dy concentration.

The size of the samples are apropriate for optical and Electron Spin Resonance (ESR) studied that are presently being carried out and will be reported elsewhere.

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