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Investigating Nanocrystalline CaF2:Tm for Carbon Beam and Gamma Radiation Dosimetry

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Abstract : In the present investigation, initially nano-particles of CaF2 were prepared by the chemical co-precipitation method and later the prepared salt was activated by thulium (0.1 mol%) using the combustion technique. The final product was characterized and confirmed by X-Ray diffraction (XRD) and transmission electron microscopy (TEM). Further, the thermoluminescence (TL) properties of the nanophosphor were studied by irradiating it with 1.25 MeV of gamma radiation and 65 MeV of carbon (C6+) ion beam. For gamma rays, two prominent TL peaks were observed with a low temperature peak at around 1070C and a high temperature peak at around 1570C. Furthermore, the nanophosphor maintained a linear TL response for the entire range of studied doses i.e. 10 Gy to 2000 Gy for both the temperature peaks. Moreover, when the nanophosphor was irradiated with 65 MeV of C6+ ion beam the shape and structure of the glow curves remained spectacularly similar and the nanophosphor displayed a linear TL response for the full range of studied fluences i.e. 5*1010 ions/cm2 to 1 *1012 ions/ cm2. Finally, various tests like reproducibility test and batch homogeneity were also carried out to define the final product. Thus, co-precipitation method followed by combustion technique was successful in effectively producing dosimetric grade CaF2:Tm for dosimetry of gamma as well as carbon (C6+) beam.

Keywords : gamma radiation, ion beam, nanocrystalline, radiation dosimetry
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