Developments in production of silica-based thermoluminescence dosimeters

ABSTRACT

This work addresses purpose-made thermoluminescence dosimeters (TLD) based on doped silica fibres and sol–gel nanoparticles, produced via Modified Chemical Vapour Deposition (MCVD) and wet chemistry techniques respectively. These seek to improve upon the versatility offered by conventional phosphor-based TLD forms such as that of doped LiF. Fabrication and irradiation-dependent factors are seen to produce defects of differing origin, influencing the luminescence of the media. In coming to a close, we illustrate the utility of Ge-doped silica media for ionizing radiation dosimetry, first showing results from gamma-irradiated Ag-decorated nanoparticles, in the particular instance pointing to an extended dynamic range of dose. For the fibres, at radiotherapy dose levels, we show high spatial resolution (0.1 mm) depth-dose results for proton irradiations. For novel microstructured fibres (photonic crystal fibres, PCFs) we show first results from a study of undisturbed and technologically modified naturally occurring radioactivity environments, measuring doses of some 10 s of μGy over a period of several months.

Keyword: Thermoluminescence dosimetry; Optical fibres; Defects; Proton beam; Environmental radioactivity