Doped silica fibre thermoluminescence measurements of radiation dose in the use of Ra-223

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Abstract

Using tailor-made sub-mm dimension doped-silica fibres, thermoluminescent dosimetric studies have been performed for alpha-emitting sources of (RaCl2)-Ra-223 (the basis of the Bayer Healthcare product Xofige (R)). The use of (RaCl2)-Ra-223 in the palliative treatment of bone metastases resulting from late-stage castration-resistant prostate cancer focuses on its favourable uptake in metabolically active bone metastases. Such treatment benefits from the high linear energy transfer (LET) and associated short path length (< 100 mu m) of the alpha-particles emitted by Ra-223 and its decay progeny. In seeking to provide for in vitro dosimetry of the a-particles originating from the Ra-223 decay series, investigation has been made of the TL yield of various forms of Ge-doped SiO2 fibres, including photonic crystal fibre (PCF) collapsed, PCF uncollapsed, flat and single-mode fibres. Irradiations of the fibres were performed at the UK National Physical Laboratory (NPL). Notable features are the considerable sensitivity of the dosimeters and an effective atomic number Z(eff) approaching that of bone, the glass fibres offering the added advantage of being able to be placed directly into liquid. The outcome of present research is expected to inform development of doped fibre dosimeters of versatile utility, including for applications as detailed herein.

Keywords

Author Keywords: Alpha particles; Silica fibre; Dosimetry; Thermoluminescence; Ra-223

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