Dosimetric characteristics of fabricated Ge-doped silica optical fibre for small-field dosimetry

ABSTRACT

We study 3 mm long germanium-doped (Ge-doped) silica fibres for small-field dosimetry, seeking to overcome spatial resolution and charged-particle disequilibrium issues, also any associated dose deviation from that of computerised treatment plan dose delivery. Investigation has been made of the thermoluminescent (TL) dependency of locally fabricated 6 mol% Ge-doped preforms subsequently made into cylindrical (CF) and flat fibres (FF), also commercial Ge-doped fibres (COMM), the dopant and mechanical strain created in fibres production providing the trapping levels generating the TL yield. A Perspex phantom was designed for study of angular dependency, fibres being positioned at angles ranging from 0° to 90° while a scanning electron microscopy with energy dispersive X-ray (SEM/EDX) analysis study allowed evaluation of relative Ge content of the three TL types. Flat Fibre dose repeatability was found to be similar to that for the commercial fibre (in the range 2%–6%), improving appreciably upon that for the cylindrical fibre (<14%), also exhibiting highly linear response up to 80 Gy ($R2 \geq 99\%$) and near angular independence (<3%). The notable signal fading of the FF (25%) would need to be carefully accounted for in applications. This work provides support for the viability of 6 mol% Ge-doped preforms subsequently fabricated into Flat Fibres for use in small-field dosimetry, offering a suitably dose-sensitive fibre arrangement.

Keyword: Ge-doped optical fibre; Thermoluminescence; Megavoltage radiotherapy; Small-field dosimetry; Elemental composition