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Investigation on various types of silica fibre as thermoluminescent sensors for ultra-high dose radiation dosimetry

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Highlights:

- 13 types silica fibres are examined as potential sensor material for high dose dosimetry
- Thermoluminescence response of fibres are obtained at dose range of 0.1 to 100 kGy
- Various fibre types show different dose level of saturation starting from 5 kGy
- Borosilicate fibre demonstrates best performance with linear response till 100 kGy
- Further dosimetric characterisation of Borosilicate fibre are presented

Abstract

With high-dose applications lacking the benefit of an economic yet versatile dosimeter that provides for a wide dynamic dose range, ongoing research is seeking to introduce suitable thermoluminescent (TL) material for such needs. Acknowledging the high potential of silica fibres, as developed by members of this group over the past few years, in present work evaluation has been made of 13 types of fibre, differing in dopant, dopant concentration and diameter including P-, Al-, Er-, Ge- and Al-Tm-doped fibres, ultra-high numerical aperture and borosilicate fibre, and two non-doped fibres, quartz and suprasil F300. Evaluation is made in terms of TL response to photon and electron irradiations with the objective of determining a TL material that can offer sensitive yet extended dose capability, saturating only above the few tens of kGy range. The various silica fibres that have been investigated were found to show saturation levels from 5 kGy for Ge-doped fibre (4 mol %) to 80 kGy for 2 mol % Al-doped silica fibre. Borosilicate fibres demonstrated the greatest potential for high dose dosimetry, maintaining a highly-linear response, any tendency towards saturation only being indicated to beyond receipt of doses of 100 kGy. For this fibre type detailed TL characterizations were

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