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The variation of dose rate dependence parameters of synthetic diamond detectors with electron energy

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Abstract content
   (Max 300 words)

The dose rate dependence parameters of eight synthetic diamond detectors have been investigated in the dosimetry of therapy electron beams according to Fowler's model. As modelled by Fowler, electrical conductivity, σ, and absorbed dose rate, Ď, are related by σ α Ďˆ Δ where Δ is the dose rate dependence parameter. The aim of the study was to investigate, in particular the dependence of Δ on electron energy as it is often cited for diamond detectors that Δ is independent of radiation energy and type. The study was conducted on one HPHT and seven CVD synthesised diamonds using two electron energies of 7 and 12 MeV. It was observed that the Δ values obtained with the CVD specimens varied with electron energy whereas the Δ values obtained with the HPHT specimen were found to be independent of the two electron energies. Given that the surfaces of the crystals could be more sensitive to the lower energy 7 MeV electron beam compared to the 12 MeV beam, a greater fraction of charge carriers could be preferentially trapped on the surfaces of the crystals for the lower electron energy compared to the higher energy if electron traps are present on or near the surfaces of the crystals. In this study, C-H centres have been identified by IR absorption spectroscopy as defects possibly located on the surfaces of the crystals with a greater concentration occurring in the CVD diamonds compared to the HPHT sample. The observed dependence of Δ on electron energy for the CVD specimens could therefore be attributed to the greater presence of surface defects such as the C-H centres which could introduce electron traps causing a variation in the number of trapped electrons relative to the number of free electrons between the surfaces and the bulk of the crystals. This study concludes that Δ could vary with radiation energy depending on the characteristics of each diamond crystal.

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Yes

Level for award
 (Hons, MSc,
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PhD

Main supervisor (name and email)
and his / her institution

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