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Characterisation of the PTW microDiamond detector for high spatial resolution dosimetry in microbeam radiation therapy at IMBL

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Microbeam radiation therapy (MRT) at IMBL is based on arrays of 50&mu m wide x-ray beams with a pitch of 400&mu m. The peak-to-valley dose ratio (PVDR) is the ratio of the peak dose to the dose between the microbeams and is an important radiobiological quantity. Accurate measurements of the PVDR require a dosimeter with high spatial resolution, dose rate independence and water equivalence for the MRT spectrum. The PTW microDiamond detector is a synthetic single crystal diamond detector. The 1.1mm radius and 1&mu m thickness make it a promising candidate MRT dosimetry. Studies have been performed at IMBL to characterise the energy, dose rate and directional dependence of microDiamond. The ratio of mass energy absorption coefficients in diamond and water predict that the detector will under-respond at low energies, however, this was not observed in the experimental ratio of the microDiamond response to absorbed dose in water for energies 30-90keV. The dose rate dependence was found to be linear for storage ring currents &ge 50mA but deviated from linearity by up to 4% for lower currents (2-50mA). The reponse of the detector oriented at 0o and 90o relative to normal beam incidence agreed to within 3%. This is an important result since the required spatial resolution for PVDR measurements exists in the 90o geometry. The detector will be calibrated against reference detectors and the kV primary standard for absorbed dose.

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Summary

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