AbstractID: 11066 Title: An image-guided micro-radiotherapy system based on carbon nanotube field emission technology for small animal irradiation for cancer research

Purpose: To demonstrate the feasibility of a nanotechnology-based micro-computed tomography (micro-CT) and micro-radiotherapy (micro-RT) integrated system (micro-CT-RT) that delivers real-time image-guided intensity-modulated radiation therapy (IMRT) for small animal irradiation.

Materials and Methods: Carbon nanotube (CNT) field emission (FE) based x-ray technology is used for the development of the multi-pixel x-ray beam array micro-RT system. The multi-pixel x-ray beam array has individual pixel control to electronically shape the radiation field and form intensity modulation patterns in the irradiated object. Monte Carlo based dosimetric simulations and electro-optical simulations have been performed to guide the micro-RT system design.

Results: A prototype multi-pixel beam array micro-RT system was designed and fabricated. The prototype can successfully generate a 5 x 10 x-ray beam array which offers a maximum radiation field size of 10 mm x 20 mm . Each beam can produce a dose rate on the order of 1 Gy/min at the center of the irradiated object.

Conclusions: The feasibility to fabricate a multi-pixel beam array micro-RT system based on CNT FE technology is demonstrated. The prototype micro-RT can generate a 5 x 10 x-ray beam array which offers a maximum radiation field size of 10 mm x 20 mm in the irradiated object. The system is still under testing and performance improvement. Once fully developed, the micro-RT system will be integrated with the nanotechnology-based prototype micro-CT already developed for real time image-guided IMRT and treatment response observation in small animals.