AbstractID: 13602 Title: Recent development of a carbon nanotube field emission based x-ray micro-radiotherapy system for small animal radiotherapy

Purpose: To develop a novel multi-pixel x-ray beam micro-radiotherapy (micro-RT) system for high-resolution small animal image-guided radiotherapy (IGRT) using carbon nanotube (CNT) field emission technology.

Materials and Methods: We have developed a prototype multi-pixel x-ray beam micro-RT device for feasibility demonstration. The micro-RT design uses a pixel beam array which consists of fifty individually addressable x-ray pixel beams, each beam is ~2 mm in size. The pixel beam array can form a maximum field size of 1 cm x 2 cm with arbitrary field shapes and intensity modulation patterns. Potential advantages of the multi-pixel micro-RT system over the single source micro-RT systems are stationary flexibility and real-time nature of the electronic field shaping. CNT field emission based imaging and irradiation systems have also ultrahigh temporal resolution, which can be very important for small animal IGRT. Previously we have demonstrated the feasibility of the system using lower beam energy and here we report the recent progress in CNT FE based micro-RT development with higher energy beams.

Results: A 100 kV prototype CNT field emission based micro-RT system is developed. The prototype device can generate 75 individual addressable multi-pixel x-ray beams. Each beam is expected to produce a dose rate on the order of >1 Gy/min at the center of the irradiated object. We also integrated our CNT field emission based micro-RT and micro-CT devices for small animal IGRT.

Conclusions: We have made significant progress in developing the novel multi-pixel micro-RT system using CNT field emission technology. It remains to be a challenge to achieve high voltage (>100 kV) and high dose rate using this highly original prototype device in an academic research laboratory environment. The CNT-based micro-RT can be integrated with the CNT field emission based micro-CT already developed for real time small animal IGRT.