AbstractID: 8479 Title: Development of carbon nanotube field emission micro-radiotherapy system for cancer research

Purpose: To demonstrate the feasibility of a carbon nanotube (CNT) field emission FE) technology based novel multi-pixel array x-ray micro-radiotherapy (micro-RT) system for fast conformal and intensity-modulated radiotherapy (IMRT) irradiation for small animals. When it is developed, the CNT FE micro-RT system will be integrated with the already developed CNT FE micro-CT for real time imaged-guided IMRT and treatment response observation in small animals.

Materials and Methods: The micro-RT system comprises a CNT pixel cathode array for individual pixel beam generation and control, a transimission anode for x-ray production, and a pixel beam collimation array to converts the Bremstrahlung x-rays to x-ray pixel beams. Each x-ray beam is 2 mm x 2 mm at the irradiation object and the beam energy should be 100 kV or higher. Micro-RT dosimetry is computed using Monte Carlo simulation techniques. A CNT cathode array for the prototype of micro-RT consists of 50 (5 x 10) individual addressable pixel cathode. The single array offers a maximum radiation field size of 10 mm x 20 mm at the irradiation object. The eventual micro-RT system is consisted of several x-ray pixel beam arrays within a donut-shape structure.

Results: We have designed and fabricated a 50-pixel beam cathode array for the prototype micro-RT. The FE current of the 50 pixel beams is uniform. Each cathode pixel is individually addressable and can produce emission current of 4 mA/pixel.

Conclusions: We have demonstrated the feasibility to fabricate the CNT FE cathode array. A micro-RT system consisted of 5 x 10 pixel beam array. The next step is to fabricate the anode and pixel beam collimation system, and assemble the entire prototype micro-RT system for feasibility demonstration. The proposed multi-pixel array x-ray micro-RT system is capable of electronically defining radiation field shape and intensity modulation pattern for small animal irradiation.