AbstractID: 7092 Title: Feasibility study of a carbon nanotube field emission microbeam system for cellualr irradiation

Purpose:
Tissue-level radiobiological effects that influence tumor control or normal tissue complications stem from processes initiated at the cellular and sub-cellular levels immediately following radiation energy deposition. The exact mechanisms of these processes at the critical moments are still poorly understood. We proposed to develop a nanotechnology based microbeam pixel array cellular irradiation system that promises to enable researchers to study the micro-processes at the spatial and temporal scale of the events. This presentation reports the feasibility study results.

Method and Materials:
A multi-pixel microbeam cellular irradiation system is proposed to selectively irradiate chosen target cells in a Petri dish under microscope observation. The microbeam system uses carbon nanotube (CNT) field emission technology. Each of the CNT pixels emits an electron beam and a silicon nitride window collimates the electron beam to a specific microbeam size. The electron microbeam has a tunable energy of 20-60 keV. Each of the pixel beams in the multi-pixel microbeam can be controlled individually. The initial phase of the research is design and development of a prototype single pixel microbeam device and cell irradiation demonstration.

Results:
We have designed and fabricated a prototype single pixel CNT field emission microbeam system and performed dose calibration. GAFCHROMIC film is used to measure absolute dose and dose distribution. Microbeam radiation dose is calibrated as dose per radiation pulse. We performed cell irradiation using the prototype microbeam device on Rat-1 cells. H2AX is phosphorylated at DNA damage sites and the microbeam irradiation pattern is confirmed by the pattern of DNA damage.

Conclusion:
We have demonstrated the feasibility of a single pixel CNT field emission microbeam for cellular irradiation. The next research step is study the feasibility of the multi-pixel microbeam array.

This work is funded by NCI (R21 CA118351) and North Carolina Biotechnology Center (2005 MRG-111)._