AbstractID: 11265 Title: Feasibility Study of Microbeam Radiation Therapy Using a Carbon Nanotube Field Emission Based Electron Microbeam Irradiator

Purpose:

Microbeam radiation therapy (MRT) is an innovative radiation therapy treatment method. It has unique capability of eliminating tumor while sparing normal tissue. Currently all the MRT studies are carried out using synchrotron based radiation facility, which in general has limited accessibility. We have recently developed a carbon nanotube (CNT) field emission based electron microbeam irradiation system. It has the potential of providing extremely high radiation dose rate (>100 Gy/sec) with high spatial and temporal beam resolution.

Method and Materials:

The electron microbeam irradiator is based on carbon nanotube electron field emission technology. The system consists of a triode type CNT field emission cathode sealed in vacuum. The cathode current is controlled by an adjustable gate electrode, while a high voltage power supply is used to create an acceleration potential between the cathode and anode. A laser drilled aperture is used as the electron beam exit window and also provides required electron beam collimation.

Results:

The CNT microbeam irradiator is capable of delivering electron radiation at extremely high dose rate (>100 Gy/sec). The beam profile was recorded using Gafchromic film (HD-810) and showed beam FWHM (full-width-at-half-maximum) about 62 μm. The measured PVDR (peak-to-valley dose ratio) is about 15:1, which is very reasonable for MRT application and can be further improved with better beam collimation. SW480 colorectal cancer cells were also irradiated using the same device for demonstration purpose.

Conclusion:

We have demonstrated the feasibility of generating high dose rate electron microbeam radiation using a carbon nanotube field emission based electron microbeam irradiator. The compact size and low cost of the device will make the device more accessible for cancer research community. The preliminary study using the as-developed electron microbeam system showed its promising future for potential MRT related research, especially at cellular level.