AbstractID: 6642 Title: The beam performance and dose distribution of a needle-based miniature X-ray generating system for medical application

Purpose:

To quantify the radiation and to assess the performance for a needle-based miniature x-ray generating system using GAFCHROMIC EBT films and ionization chambers on low photon energy.

Method and Materials:

A needle-based miniature x-ray generating system (Advanced X-Ray Technology, Inc.) has been developed for intraoperative brachytherapy with a great dose fall off in certain directions. The system comprises a conventional x-ray tube with an Ag anode and a 9.5 mm diameter needle device with an interchangeable Mo target. The secondary x-rays from the Mo target are mono-energy (Kα, 17.5KeV) beam with a ring-type dose distribution. Ionization chambers and GAFCHROMIC EBT films were used to measure the stability, linearity, uniformity, half-value layer, and air dose rate of the primary beam, as well as the isodose distribution of the secondary x-ray beam. Each irradiated film was calibrated with the average OD over the center area of $2x2cm^2$ on the film. An average OD over $5x5cm^2$ area on films in the same film batch was determined as the background.

Results:

The primary beam with a power setting of 58 kVp and 25 mA has ~0.36Gy/min air dose rate at 91cm, <2% flatness for 3 x 3 cm field, ~0.554 mm Al half value layer, and excellent stability and linearity (<1% deviation). For the secondary Mo mono-energy beam (17.5KeV), reading from a micro-chamber provided the radial dose function in air from 6.19 mm to 12.19 mm from the target center. The maximum dose (253cGy) measured by EBT film at 7.48mm from the target center agreed with the micro-chamber measurement (260cGy).

Conclusion:

The measurements of radiation output and isodose distributions and the evaluation of the system performance provided us the characteristics of the two stage x-ray generator and they are essential parameter for its medical application.