SU-F-T-550: Radiochromic Plastic Thin Sheet Dosimeter: Initial Performance
K Jordan, J Adamovics -
2016 Medical physics, 3589-3590

Purpose: Thin sheets, of a high sensitivity formulation of radiochromic dosimeter, Presage were prepared and evaluated for optical readout. Methods: Sheets of radiochromic polyurethane, 12 cm long, 10 cm wide and 0.2 cm thick were prepared with leuco crystal violet as the reporter molecule. Sample transmission was evaluated at a wavelength of 590 nm with in-house constructed instruments: optical cone beam laser CT scanner, fixed and scanning spot densitometers. Sample sequential irradiations to a total dose of 40 Gy were conducted with a modified, Theratron 60, cobalt radiotherapy machine at dose rates of 1 or 0.25 Gy per minute. Exposure to ambient and readout light was minimized to limit background photochromic signals. Samples were stored at 4 C. Optical activity was assessed from linearly polarized transmission images. Comparison sensitivity measurements with EBT3 film were conducted.
Results:
Samples were transparent, smooth and pale purple before irradiation. Radiochromic reaction was completed in less than 5 minutes. A linear dose response with a sensitivity of 0.5 cm-1Gy-1 was observed. Micrometer measurements found sheet thickness variations up to 20%. Uniform dose, 2 Gy attenuation images, correlated with local sheet thicknesses. Comparable measurements with EBT3 film were 3 times more sensitive at 1 Gy but above 15 Gy, EBT3 film had lower sensitivity than 0.2 cm thick Presage sheet dosimeter due to its non-linear response.
Conclusion:
Dose sensitivity provided a 10% decrease in transmission for a 1 Gy dose. Improvements in mold design are expected to allow production of sheets with less than 5% variation in thickness. Above, 10 Gy, Presage sheet dosimeter performance expected to exceed EBT3 film based on linearity, sensitivity, transparency and smoothness of samples.

SU-G-TeP2-06: Development of Novel Radiochromic Films for Radiotherapy Dosimetry
M Alqathami H Lee G Won Choi A Blencowe Z Wen J Adamovics G Ibbott
2016 Med ical Physics 07 June 2016 https://doi.org/10.1118/1.495704

Purpose:
To develop and evaluate novel radiochromic films for quality assurance in radiotherapy dosimetry.

Materials and Methods:

Novel radiochromic film compositions were formulated using leuco crystal violet (LCV) as a reporting system and tetrabromoethane as a free radical source. The film matrix used consisted of polyurethane polymer mixed with dibutyl phthalate plasticizer (20 wt%). The concentration of the radical initiator was kept constant at 10 wt% and the concentration of the LCV dye varied (1 and 2 wt%). To ensure uniform thickness of the film, its precursors were sandwiched between two pieces of glass separated by a 1 mm gap between during the curing process. The films were cut into pieces and were irradiated with a 6 MV X-ray beam to selected doses. The change in optical density was measured using a flatbed scanner and a spectrophotometer.

Results:

The results showed that all film formulations exhibited a linear response with dose and an absorption maximum at ~ 590 nm. The formulation with 2 wt% LCV was ~ 30% more sensitive to dose than the formulation with 1 wt% LCV. Both films were very deformable. In addition, the radiochromic response of the film was found to bleach over a short period of time (few weeks) allowing the film to be reused for dose verification measurements.

Conclusion:

Both film formulations displayed excellent sensitivity and linearity to radiation dose and thus can be used for the 2D dosimetry of clinical megavoltage and kilovoltage X-ray beams. In addition, the thickness of the film could easily be increased allowing for their potential use as a deformable bolus material. However, thicker films would need more optimization of the manufacturing procedure to ensure consistent material uniformity and sensitivity are recommended.