AbstractID: 13106 Title: Development and Evaluation of a Low Cost, EBT2 Film-Based Real-Time Dosimeter

Purpose: To develop and evaluate a low-cost GafChromic film-based real-time dosimeter for practical radiation dosimetry.
Method: The dosimeter employs EBT2 film chips, LEDs at 680 nm and 618 nm, a photodiode, and plastic optical fibers. Red light from the LED, modulated by sinusoidal signal, is guided with a ϕ=1 mm fiber toward a film chip as small as 2×2 mm^2. Transmitted light is carried by another ϕ=0.5 or 1 mm fiber toward the photodiode. A Java program generates the sinusoidal signal, samples the photodiode signal and computes its amplitude in real time via FFT. Dose response to 6MV photon beams was characterized with a Siemens Primus linac and a Varian Novalis radiosurgery linac. S_{cp} of the Novalis linac was measured down to 0.6x0.6 cm^2 using multiple film chips.
Results: The dosimeter has 16-bit resolution with a SNR of ~80 dB. At 680 nm, optical density responded to dose linearly at ~10^{-4}/cGy up to 75 Gy. At 618 nm, response was approximately 30 times greater. Response was non-linear but easily approximated with a cubic polynomial. The accuracy of the dosimeter was estimated to be better than 2% if the film is allowed to settle for one day. The accuracy of the real-time dosimetry is affected by the settling time the optical density takes to reach asymptotic value. The S_{cp} measured by the dosimeter was comparable to ion chamber and diode detectors down to sizes of 4.2×4.2 cm^2, but was reduced as field size decreased, e.g. by ~4% at 1.2×1.2 cm^2.
Conclusions: A real-time, low-cost dosimeter was developed based on radiochromic-film at 618 nm. It can be easily implemented and conveniently used for in-vivo dosimetry given its demonstrated accuracy.

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