

Purpose: To develop a new generation energy-independent radiochromic film over a wide energy range of 50 kVp to 18 MV. The films are preferably symmetric in structure and can be used for measurements in complex spectral distributions.

Methods: The overall energy dependence and intrinsic energy dependence were measured for EBT2 and several prototype films of known compositions. The intrinsic energy response is quantified through a measurement of total energy response divided by the Monte Carlo calculated absorbed dose energy response. The measurements consisted of delivering an exact dose of 2 Gy to the sensitive layer of the film at both orthovoltage energies (50kVp, 120kVp, and 180kVp) and ⁶⁰Co beam. Thus far, two iterations have been performed, whereby; numerical simulations are used to obtain an optimized absorbed dose energy response that will undo for the film intrinsic energy response. DOSRZnrc user-code of the EGSnrc Monte Carlo code was used for all simulations. AAPM TG51 and TG61 were used to determine the dose-to-water and air-kerma in air in megavoltage and orthovoltage beams, respectively, while Monte Carlo simulated corrections were used to convert these results to the desired dose to film.

Results: For EBT2 films the overall energy dependence was found to vary by 35% over 50 kVp to Co-60 energy range. The latest prototype measured in this work has shown a total net variation of 8% over the same range. High atomic number elements (Chlorine and bromine) were found to affect absorbed dose response drastically. The iterative optimization technique has placed a large focus in accurately determining the elemental composition.

Conclusions: We have quantified the intrinsic energy dependence of radiochromic films, and have used the data to numerically optimize the composition of the active layer to produce an energy-independent film with an 8% energy variation over a wide energy range.

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Conflict of interest: ISP is a manufacturing company of GAFCHROMICTM films.