Dosimetry with GAFCHROMIC® EBT Films

1 General

GAFCHROMIC EBT is a self developing film produced by ISP (International Specialty Products) for dosimetry in radiotherapy.

Features of EBT films:

- Dose range for EBT type is 1 cGy - 800 cGy (HS type is ten times less sensitive)
- Maximum sensitivity at 636 nm

2 Film Dosimetry with GAFCHROMIC

2.1 Scanner Types

Following scanners have been tested by PTW with GAFCHROMIC® EBT films:

- VIDAR DosimetryPRO Advantage (red)
- Microtek 1000 XL
- Epson 10000 XL

All of them can be used with EBT films with PTW-Software. PTW did not verify the manufacturer’s specifications.

Scanner types with different light sources:

- Laser scanner
  HeNe laser scanners (like Kodak Lumisys) provide the highest response with EBT film because the laser has a wavelength of about 633 nm, very close to peak absorbance. However, the coherent light of the laser scanners can produce artifacts caused by the interaction of polarized light with the film. Where the wavelength is not close to peak absorbance (like Radlink LaserPro 16) the contrast is not sufficient for dosimetry.

- Flatbed scanner
  For flatbed scanners like Microtek 1000XL or Epson 10000XL with white light source, the red channel has to be extracted from the RGB scan to improve the quality, which can be done with the FilmScan software via TWAIN interface. The Epson flatbed scanner with the white light source has a good cost-performance ratio.

  - VIDAR DosimetryPRO Advantage (red)
    The scanner uses a red LED light source, which is optimized for GAFCHROMIC EBT films. The previous version “DosimetryPRO Advantage” with white light source can also be used but this version offers only a grayscale image and the red light cannot be extracted, which means reduced evaluation quality. With both versions scans can be done with PTW-FilmScan directly or via USB and TWAIN interface.

2.2 Film Scanning

Special properties of the film have to be considered in order to optimize the evaluation result:

- Due to different light scattering depend on the orientation of the film it is important to use it always in the same orientation
- Film should be always scanned at the same scanner position
- Time difference between irradiation and scanning should be constant
- Due to increased noise, the software should provide a sufficient aperture area to calculate the mean value for calibration
- For scanner with white light source, the red channel should be extracted from a RGB image
- Due to a batch dependent film inhomogeneity, a flattening correction with a non irradiated or homogeneous irradiated film improve the result
2.3 Complete Solution with PTW-Software

Film dosimetry can be done with following PTW-Software packages:

FilmSoft, VeriSoft and MEPHYSTO mc² with option FilmAnalysis

All software packages include the complete GAFCHROMIC functionality.

Depending of the options of the scanner a direct link or TWAIN interface can be used. In both cases the result is a gray value tif file.

Use following procedure once in order to provide an optimum scanning result:

- In FilmScan options:
  - Select the scanner
  - For RGB scanner select GAFCHROMIC optimized to extract the red channel (See Figure 1)
  - Set median filter size to smooth the correction and evaluation area to normalize the corrected dose to a limited area around the film center (See Figure 2)
- In the TWAIN interface for RGB flatbed scanner select 48 bit and do not activate any corrections
- Create scans from one or several films with areas of known dose
- Use FilmCal to create a calibration lookup-table from these films. Use an enlarged aperture and check the standard deviation in the status bar to make sure that the area is not to noisy
- Activate the calibration in FilmScan with ‘Set Lookup-Table’
- Scan and activate a correction image (File -> Scan Correction Image) with a non (or flat) irradiated film from a film batch
- Check in the status bottom line that flattening correction and lookup-table are set

For your routine scanning, make sure that

- Each film is from the same batch as the corrected film
- Film orientation and position is the same as from the corrected film
- Time difference between irradiation and scanning should be the same as for calibration

Figure 1: FilmScan TWAIN interface

Figure 2: FilmScan Flattening Correction

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