Canadian Association of Physicists

Association canadienne des physiciens et physiciennes

Contribution ID: **89** Type: **Oral Competition (Undergraduate Student) / Compétition orale (Étudiant(e) du 1er cycle)**

High spatial resolution dosimetry using Raman micro-spectroscopy readout of radiochromic films

Monday 8 June 2020 15:36 (15 minutes)

Purpose
Micrometer-scale spatial resolution and sensitivity to low doses remain a challenge for radiation dosimetry, however, these are essential to advancing areas of radiation therapy and understanding health risks from low dose radiation exposures. The purpose of this work is to develop a new approach for high spatial resolution dosimetry based on Raman micro-spectroscopy scanning of radiochromic film that provides improved sensitivity to low doses, an extended range for the dose-response curve in addition to high dose uniformity.
Methods
Samples of EBT3 radiochromic film (RCF), were irradiated at a broad dose-range of 0.03-50 Gy using an Elekta Precise clinical linear accelerator. Raman spectra were acquired with a lab-built Raman micro-spectroscopy setup involving a 500 mW, multimode 785 nm laser. The custom optical design enabled the concurrent collection of Raman spectra from the RCF active layer and the polyester laminate. Raman spectra were corrected for background noise and instrument spectral deviations. Spectra were normalized to the intensity of the 1614 cm-1 Raman peak corresponding to the polyester laminate which was shown to be unaltered by radiation. The peak intensities at 1445 and 2060 cm-1 Raman bands in the active layer of the RCF were used to generate a dose-response curve. Dose uniformity was assessed by taking the ratio of two Raman peak intensities in the active layer.
Results
Radiation induced changes in the RCF were measured for a wide range of doses from 0 to 50 Gy. The generated dose-response curve followed a linear trend until ~10 Gy. The dose non-uniformity determined from averaging spectra over a pixel size of 15 µm was determined to be less than 2% for doses greater than 0.15 Gy.
Conclusions
This work highlights the potential of Raman micro-spectroscopy to produce meaningful dose-estimates that could support applications that require high spatial resolution dosimetry.

Authors: Mr MCNAIRN, Connor (Department of Physics, Carleton University); Mr CLARK, Taylon (Department of Physics, Carleton University); Mr MANSOUR, Iymad (Department of Physics, Carleton University); Dr MUIR, Bryan (National Research council); Dr CHAUHAN, Vinita (Consumer and Clinical Radiation Protection Bureau, Health Canada); Dr THOMSON, Rowan (Department of Physics, Carleton University); Dr MURUGKAR, Sangeeta (Department of Physics, Carleton University)

Presenter: Mr MCNAIRN, Connor (Department of Physics, Carleton University)

Session Classification: DPMB Best Student Oral Presentations

Track Classification: Physics in Medicine and Biology / Physique en médecine et en biologie (DPMB-DPMB)