AbstractID: 11804 Title: Quantitative radiation therapy dosimetry using reusable storage phosphor KCl:Eu2+

Purpose: To investigate the quantitative use of a novel KCl:Eu^{2+} dosimeter for radiation therapy dosimetry.
Methods and Materials: Cylindrical KCl:Eu^{2+} dosimeters 7 mm in diameter and 1 mm thick were fabricated. Dosimetric properties were studied with an in-house optical readout system after irradiation by a linear accelerator. The overall experimental uncertainty was estimated to be within ±2.5%.
Results: 1) KCl:Eu^{2+} showed satisfactory radiation hardness. There was no significant change in the stimulation spectra after irradiation up to 200 Gy when compared to a fresh sample, indicating that this material could be reused at least 100 times if 2 Gy per use was assumed, e.g., for a patient-specific IMRT QA; 2) KCl:Eu^{2+} exhibited supra-linear response to dose after irradiation from zero cGy to 800 cGy; 3) After x-ray irradiation the PSL signal decayed with time and eventually reached a plateau (0.1% per hour) after 12 hours, which was significantly better than a commercial CR (computed radiography) plate; 4) The sensitivity of the dosimeter was independent of the dose rate ranging from 15 cGy/min (underneath a MLC) to 1000 cGy/min; 5) The sensitivity showed no energy dependence for either open x-ray or megavoltage electron fields; 6) Over-response to low-energy scattered photons was comparable to radiographic film, e.g., a Kodak EDR2 film. Reduction of dosimeter thickness to tens of microns would minimize the energy dependence.
Conclusion: We have demonstrated that KCl:Eu^{2+} dosimeters have many desirable dosimetric characteristics and that KCl:Eu^{2+} has great potential to replace $BaFBr_{0.85}I_{0.15}$:Eu^{2+} as the primary storage phosphor material for radiation therapy dosimetry. In the future, a large-area KCl:Eu^{2+} based CR plate created using modern thin film techniques would provide a reusable, quantitative, high-resolution two-dimensional dosimeter with minimal energy dependence.
This work is supported in part by an NIH grant CA131690.