

Photostimulable storage phosphor dosimetry

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The feasibility of employing alkaline earth sulfide based photostimulable storage phosphors for relative dosimetry in radiation oncology has been investigated. The dosimetric characteristics, radiologic characteristics, and spacial sensitivity of calcium sulfide and strontium sulfide based phosphors were determined. Dosimetric characteristics were explored by cavity theory calculation, Monte Carlo simulation, and physical measurement. Dosimetric characteristics obtained with cavity theory and Monte Carlo simulations agree well. The dose perturbation of the phosphor base materials were comparable to those produced by clinical dosimeter materials over the energy region employed in radiation oncology. Dose perturbation in regions downstream of the phosphor were measured with a variety of clinical dosimeters and compared with simulation results. The results of the measurements and simulations agreed within the uncertainty levels of the simulations and the measurements. Radiological characteristics of sensitivity, fading, dose response, dose rate response, and energy dependence of response were studied with an experimental phosphor output reader. Relative sensitivity was found to be dependent upon the mass thickness of phosphor layer. Fading was quantified for the calcium sulfide phosphor, with a half time of 2300 minutes. The strontium sulfide sample exhibited some fading, however, the regression lines yielded low correlation coefficients. A linear dose response over the range of doses employed in radiation oncology was obtained for both phosphors. No significant dose rate dependence of response was measured for the phosphors. The phosphor's energy dependence of response paralleled the dose perturbation relative to water predicted by cavity theory and simulations. Spatial sensitivity was demonstrated with an experimental phosphor scanner. The phosphors exhibited spatial sensitivity, however, infrared scattering/piping in the transparent substrate appeared to cause depletion in the portions of the phosphor scanned last and a subsequent under response. In summary, the phosphor materials exhibit all of the characteristics necessary for relative dosimetry. Several of the phosphors' characteristics are comparable to those of the only clinical multidimensional dosimeter, radiographic film. The current study has demonstrated the potential use of these materials in relative dosimetry.