

AbstractID: 2069 Title: Two-Phase Nanoscale Polymer Gels for Quantitative 3D Radiation Dosimetry

Rapid expansion of intensity modulated and 3D conformal radiation therapy requires high-resolution, accurate 3D dosimetry and quality assurance methods. We present a feasibility study of a novel two-phase nanoscale polymer gel for quantitative 3D radiation dosimetry. The new system relies on radiation-induced free-radical polymerization of hydrophobic monomers that are confined to within nanometer-scale micellar particles, uniformly dispersed in an aqueous gel. We use reaction conditions similar to emulsion polymerization that yields nano-scale particle size with narrow size distribution. Therefore, the nanoscale-polymer gel structure can be described as a "single-hit 3D photon counter" that is linear with dose and dose-rate independent. Moreover, because the hydrophobic monomers are separated from the continuous aqueous phase and from the molecules of the gelling agent, water-soluble impurities have no effect on the polymerization. This imparts reproducibility, accuracy and stability on the dose response. As a result, the nanoscale polymer gels are expected to be more suitable than the existing single-phase gels for the quantitative 3D radiation dosimetry.

Precursor monomer materials have been selected based on polymerization rate, volume shrinkage, optical properties, cost and toxicity. Various gelling agents, solvents, surfactants and oxygen scavengers are investigated. Oil-soluble monomers are dispersed in the aqueous gel using surfactants, with or without co-surfactants, to control micelle size. The ratios of surfactant to monomer and surfactant to solvent are optimized to obtain nanometer-size micelles. Dynamic light scattering (DLS) is used to measure the particle size and analyze its size distribution.

This work is supported by NIH under SBIR grant 1R43CA94540-01A1.