

AbstractID: 6533 Title: Monomer diffusion in BANG polymer gel during irradiation: a theoretical study

Previous studies with BANG polymer gel dosimeters showed a formation of enhanced edge in a steep dose gradient region when absorbed dose exceeds the linear response region of the gel. We assume that this is caused by the diffusion of monomers due to a concentration gradient formed by monomer consumption. The BANG polymer gel is composed of acrylic acid monomers and cross-linking bis molecules in aqueous gel. Upon irradiation, monomers and bis molecules bind and they form macromolecules (or polymers). In a high dose region the monomers are depleted faster than in a low dose region. Hence, a monomer concentration gradient develops and the monomers diffuse into the higher dose region. The concentration gradient of polymers is opposite to monomers, but we assume polymers do not diffuse. We have modeled this phenomenon in one dimension using coupled time-dependent rate-diffusion equations for monomers and polymers. By assuming a quadratic dose distribution, an analytic solution is obtained with a uniform monomer distribution as an initial condition. The solution displays a possibility of the edge formation when there is monomer diffusion. The diffusion coefficient of monomers can be estimated to be about $1 \times 10^{-6} \text{ cm}^2/\text{s}$. The diffusion coefficient is smaller than that of ferric ion diffusion in ferrous gel. The diffusion can be important when dose in very steep gradient regions is measured by the BANG dosimeter and the irradiation time is long such as dosimetry of low dose rate radioactive sources.