SIMULATION OF THE DIFUSION OF FERRIC IONS IN FRICKE-GEL DOSIMETERS WITH A VARIABLE DIFUSION COEFFICIENT

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Abstract

Dosimetry in three dimensions allows the confirmation and a better understanding of a treatment in Radiotherapy. Fricke-Gel dosimeters are tissue equivalent and can be molded in different geometries and volumes. After the irradiation, the assessment of the irradiated volumes can be performed with magnetical resonance imaging (MRI) or optical-CT. On both cases, the quality of the images can be compromised by the mobility of the ferric ions (Fe^{3+}), formed during the the interaction of the radiation with the matter, increasing the uncertainty in the determination of the isodoses in the volume. In this work, the phenomenon of the diffusion of the ferric ions formed by an irradiated region is simulated in a three-dimensional domain considering a variable diffusion coefficient. This dynamic is modeled by a partial differential equation and solved numerically by an ADI algorithm. Graphical visualizations of the phenomenon are presented for better understanding of the process.

References

[1] C. C. Cavinato, L. L. Campos, "Padronizao do Mtodo de Dosimetria Fricke-Gel e Avaliao Tridimensional de Dose Empregando a Técnica de Imageamento por Ressonância Magnética", Dissertao de Mestrado - IPEN, 2009

[2] J. W. Thomas, "Numerical Partial Differential Equations: Finite Difference Schemes" (texts in Applied Mathematics 22), 1st ed., Springer, New York, NY, USA (2010)

[3] P. Barone e G. Sebastianini, Solving an Inverse Diffusion Problem for Magnetic Ressonance Dosimetry by a Fast Regularization Method, *Real-Time Imaging*, vol. 7, pq. 21-29