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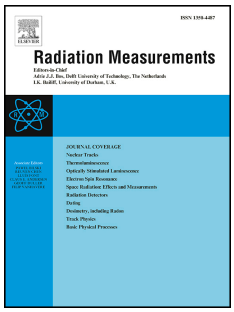

Windowless extrapolation chamber measurement of surface dose rate from a $^{90}Sr/^{90}Y$ ophthalmic applicator

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ACCEPTED MANUSCRIPT

Windowless extrapolation chamber measurement of surface dose rate from a ^{90}Sr/^{90}Y ophthalmic applicator

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Highlights

- Surface dose rate to water was measured with a windowless extrapolation chamber.
- Capacitance measurements were performed to initialize the chamber air gap.
- Monte Carlo based correction factors were derived for the windowless chamber.

Abstract

In this study, a planar extrapolation chamber without an entrance window was tested through measurements of a ^{90}Sr/^{90}Y ophthalmic applicator that had been previously calibrated at the National Institute of Standards and Technology (NIST). This work was performed as part of a larger aim to determine surface dose rate from curved ^{106}Ru/^{106}Rh plaques using a convex windowless extrapolation chamber. Capacitance measurements were carried out to assess the initial air gap width between the source face and collecting electrode. The EGSnrc DOSRZnrc Monte Carlo user code was used to determine correction factors for backscatter, divergence, and attenuation caused by the aluminized Mylar® entrance window in the NIST extrapolation chamber. Measured surface dose rate values were compared with the expected result from the NIST source calibration, and the average observed difference was +4.1% with a standard deviation of ±0.6%. The dose rate from each measurement trial was within the estimated combined uncertainty in the reference source calibration of ±7.0% (k=2) given by NIST. The experiment results suggest that an entrance window is not needed to achieve accurate dose rate measurements for a beta-emitting source with a planar extrapolation chamber, as long as the collecting electrode diameter is small compared to the source diameter. Therefore, a convex extrapolation chamber without an entrance window is proposed for the calibration of concave ^{106}Ru/^{106}Rh episcleral plaques.

Keywords

brachytherapy, episcleral, ocular, beta, extrapolation chamber

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