An extrapolation chamber for the establishment of a primary radiation standard in ^{85}Kr and ^{147}Pm beta radiation beams

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Introduction

At the Calibration Laboratory (LCI) of the IPEN/CNEN, studies are in development on the establishment of the Böhm extrapolation chamber model 23392 as a primary standard system for the dosimetry and calibration of beta-radiation sources and detectors. This chamber was already characterized at the LCI in ^{90}Sr/^{90}Y beams using two different entrance windows: one of aluminized Mylar and another of Hostaphan. This extrapolation chamber was characterized in ^{85}Kr and ^{147}Pm beams. All tests were carried out with the reference ^{90}Sr /^{90}Y source, for comparative purposes.

Methods

A Keithley model 6517B electrometer was used for the measurements. The utilized radiation sources are part of the Beta Secondary Standard BSS2. Moreover, the Monte Carlo code MCNP5 was used to determine the absorbed dose rates and to compare them with the experimentally determined dose rates and with those from the PTB calibration certificate.

Results

Saturation curves, ion collection efficiency, ion recombination, polarity effect, response stability, real null depth, linearity of response, variation of response as a function of source-detector distance, extrapolation curves, correction factors and absorbed dose rates were obtained. The ion collection efficiency was greater than 99%; the ionic recombination was less than 1%, and the polarity effect was greater than 1%. The stability of the response was lower than 0.15% for the repeatability test, and it was less than 0.36% for the reproducibility test. The difference between the experimental absorbed dose rates and those from the Monte Carlo model, compared to those from the calibration certificate, was less than 1.9% for all sources.

Conclusions

All results of the performed tests are within the limits of the international recommendations. The results for the ^{90}Sr/^{90}Y source were in the good agreement with previous works performed at LCI. These results are suitable for the establishment of a primary standard for beta radiation.