
MEASUREMENT OF THE ABSOLUTE GAMMA-RAY EMISSION INTENSITIES FROM THE DECAY OF ^{103}Pd

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ABSTRACT

Palladium-103 is a radioisotope of interest in medical applications which is used in brachytherapy implants for the treatment of prostate cancer. It decays through electron capture to excited levels of ^{103}Rh , and especially (99.959 %) to the 39.756 keV metastable state. The radioactive equilibrium between ^{103}Pd (half-life = 16,991 (19) d) and $^{103\text{m}}\text{Rh}$ (half-life = 56,114 (12) min) is reached within about 9 hours. Up-to-now, only the photon emission intensity of the main line (357 keV) was directly measured, the other being obtained from calculations taking into account the transition multipolarities and conversion coefficients.

The initial Pd-103 solution (palladium chloride), supplied by NORDION, was first checked for radioactive purity: the detection limit was less than $2 \cdot 10^{-4}$ Bq.Bq⁻¹.

The half-life of ^{103}Pd was measured by gamma-ray spectrometry on a HPGe detector on an aliquot of the diluted solution, for 50 days. The measurement was carried out by following the peak area corresponding to the ^{103}Pd main line (357 keV) and the resulting half-life is 17,106 (58) d, in agreement with the tabulated data.

The absolute photon emission intensities were obtained by gamma-ray spectrometry using a solution whose mass activity was obtained by liquid scintillation, using the TDCR method.

Point sources were prepared and measured on two high-purity germanium detectors; a coaxial one was used for the energy range between 50 keV and 500 keV and the X-rays and low-energy gamma-rays were measured a planar one. The full-energy peak efficiency of the detectors were previously calibrated with LNE-LNHB standard sources, with relative standard uncertainties between 0.5 % and 1 %.

The 357-keV photon emission intensity per 100 disintegrations obtained is 0.02464(16), in perfect agreement with the tabulated data (0.0246 (6)), and with a reduced uncertainty. In addition, the emission intensities of five other gamma-rays was also derived with a significant reduction of the uncertainties. These results should provide new information to evaluate the ^{103}Pd decay scheme, which will be discussed.