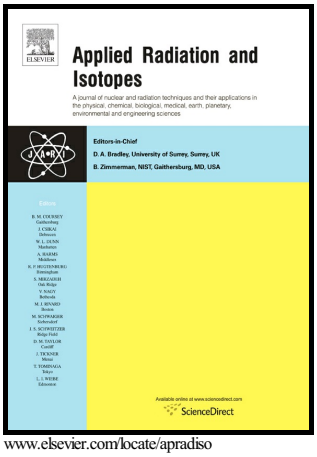

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Determination of HPGe Peak Efficiency for Voluminous Gamma-ray Sources by Using an Effective Solid Angle Method

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Summary

A code called EXVol has been developed to obtain the absolute peak efficiency for an extended or voluminous γ-ray source. The method is based on the concept of effective solid angles. Several efficiency curves that have been determined semi-empirically for voluminous sources are compared with the experimental values based on certified reference volume sources. To study the geometric and matrix effects, standard γ-ray sources of several media, volumes and shapes were measured using HPGe detectors with three different efficiencies. For the n-type detector of 32% relative efficiency, the relative deviations are less than ±10%; this performance is similar to that of existing programs for similar purposes. The EXVol code is able to calculate the detection efficiency within approximately five minutes or less. Systematic errors based on EXVol input parameters, which are mainly due to the inherent uncertainty in the detector's characteristic dimensions provided by the vendor, are studied to obtain more accurate specifications of the detectors.

Key words: Effective solid angle, Attenuation effect, Detection efficiency, Voluminous γ-ray source

1 Introduction

In γ-ray spectrometry using HPGe detectors, peak efficiency is one of the important parameters for quantifying the activity of radioactive samples, but is not easy to determine for a real geometry unless standard sources of the same geometry and matrix are used. The voluminous sample and its containers, the complicated detector geometry and the adjacent multiple layers between the sample and the detector cause complex attenuation and self-shielding effects. Multiply scattered radiations should also sometimes be