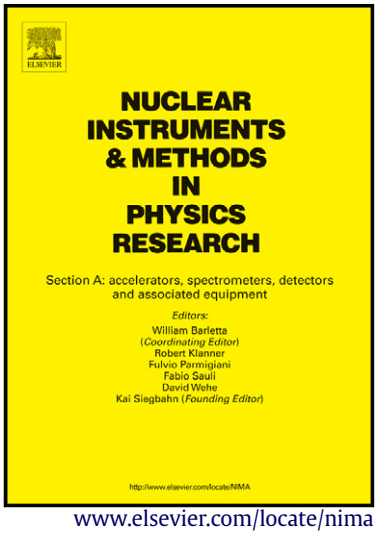

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Efficiency calibration of x-ray HPGe detectors for photons with energies above the Ge K binding energy

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Abstract

We report on the efficiency calibration of a HPGe x-ray detector using radioactive sources and an analytical expression taken from the literature, in two different arrangements, with and without a broad-angle collimator. The frontal surface of the Ge crystal was scanned with pencil beams of photons. The Ge dead layer was found to be nonuniform, with central and intermediate regions that have thin (μm range) and thick (mm range) dead layers, respectively, surrounded by an insensitive ring. We discuss how this fact explains the observed efficiency curves and generalize the adopted model. We show that changes in the thickness of the Ge-crystal dead layer affect the efficiency of x-ray detectors, but the use of an appropriate broad-beam external collimator limiting the photon flux to the thin dead layer in the central region, leads to the expected efficiency dependence with energy and renders the calibration simpler.

Keywords: x-ray detectors, HPGe detectors, efficiency calibration, dead layer, Seltzer model, detector scan

1. Introduction

HPGe detector crystals can have thick dead layers which affect their efficiency and response to photons [1–3] and can change with time [4, 5]. As reported by Debertin and Helmer [6], Keyser and Hensley [7], Schläger [8]