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Title

A rapid measurement method for the deposition velocity of thoron progeny based on an imaging plate

Abstract

The study of the deposition behavior of ^{220}Rn progeny is crucial for the assessment of public and occupational radiation doses and for controlling progeny concentration in a thoron chamber. To address the difficulty of maintaining stable environmental conditions over long durations when studying deposition velocity variations, a rapid and accurate method for the deposition velocity measurement of ^{220}Rn progeny is proposed in this study, based on a BAS-TR imaging plate (IP), which has advantages of high sensitivity, large detection area and portability. In this research, measurement procedures were optimized based on the analysis of uncertainty, whereby the total time for a single measurement can be limited within 8 h. A dedicated Python program was developed for the automatic processing of IP count data, and key parameters such as IP detection efficiency, IP scanner sensitivity, and IP fading correction were determined through experiments. Comparative experiment was conducted between IP and a calibrated alpha spectroscopy, with results showing good agreement between two method. This method was preliminarily applied on ^{220}Rn progeny deposition velocity measurement using collection plates of different sizes. Compared to traditional techniques, multi-sample, large-area measurements of deposition velocity can be completed within 8 hours using the proposed method, thereby providing an new efficient approach for the study of the deposition of ^{220}Rn progeny and other radionuclides.