

Preliminary Study of PIPS based Beta Detector for ^{85}Kr Analysis

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Keywords: Krypton analysis, Beta Spectroscopy, semiconductor detector, Monte Carlo simulation

One of the anthropogenic source of the radioactive noble gas ^{85}Kr (beta emitter, E_{max} : 687 keV, half-life : 10.76 years) is nuclear-fuel reprocessing. It is significant to detect the nuclear activities of neighboring countries such as clandestine separation of plutonium for the preparation of nuclear weapons owing to chemically stable property of gas. Therefore, it is necessary to monitor of radioactivity of ^{85}Kr in the atmosphere and to develop reliable method to analyze ^{85}Kr . To determine the radioactivity of ^{85}Kr in the atmosphere, usually, the optimized gas proportional counter made by a Bundesamt für Strahlenschutz - Institute of Atmospheric Radioactivity (BfS-IAR) has been used. However, it has a limit for the *in-situ* long term monitoring of nuclear activities because of P-10 gas change. In this study, we developed ^{85}Kr monitoring system using the Passivated Implanted Planar Silicon (PIPS) to replace the gas proportional counter. The PIPS detectors are widely used for alpha spectroscopy, radon analysis, and gross alpha and beta analysis. However, ^{85}Kr monitoring system using PIPS has not developed yet. We designed the system using Monte Carlo simulation, and demonstrated experimentally using 450 mm² surface area and 500 μm thickness PIPS detector (PD-450-500, Mirion) and digitizer (DT-5730, Caen). ^{36}Cl sources were used in the experiment because they emit beta energy similar to ^{85}Kr radionuclide. Using a ^{36}Cl (beta emitter, E_{max} : 710 keV, half-life : 301,300 years) source with 0.0979 μCi activity, measurement were made for 10,000 seconds at a distance of 5 mm from the PIPS detector and compared the Monte Carlo simulations. Obtained by the simulation and experiment energy spectrums of ^{36}Cl beta ray are well matched. From our results, we made sure of the possibility of ^{85}Kr detection using PIPS and we will test ^{85}Kr gas in the foreseeable future.

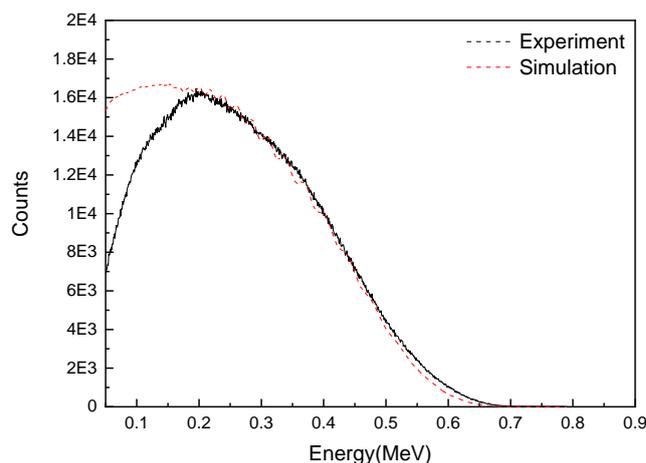


Fig. 1. ^{36}Cl Energy spectrum of Monte Carlo simulation and PIPS detector experiment.

Acknowledgments

This work was supported by the Korea Foundation of Nuclear Safety (KoFONS) Grant funded by the Nuclear Safety and Security Commission (NSSC) (1705007-0420-SB110).