Design of Radioactive Krypton Detection System Using PIPS Detector

Mee Jang · Jinhyung Lee · Hyuncheol Kim · Won Yong Kim · Wanno Lee
Korea Atomic Energy Research Institute, Daejeon, Korea

Introduction

- **Because radioactive krypton is one of the nuclear by-products released during nuclear test or reprocessing, and if we detect the radionuclide at the atmosphere, it will be a strong evidence of nuclear test or reprocessing.**
- **In Korea, the gas proportional counter made by a BfS-IAR was operated to monitor the unreported nuclear activities of neighboring countries.**
- **Because the system was needed continuous P-10 gas injection, it is difficult to operate and maintain the system developed in remote areas.**
- **Therefore, it is necessary to develop a compact and modular radioactive krypton monitoring system to maintain easily.**

Methods

- **For the measurement of ^{85}Kr with a maximum energy of 687 keV, a PIPS detector with a large area in contact with the sample has a great advantage in improving detection efficiency.**
- **In the view of a thickness, the overall efficiency is similar for a thickness of 300 ㎛ or more. However, a thickness of 500 ㎛ or more is suitable to increase the reaction probability in the high energy region.**
- **In this study, the system design was conducted using PIPS with a wide area 450 ㎟ or more among products with a thickness of 500 ㎛.**

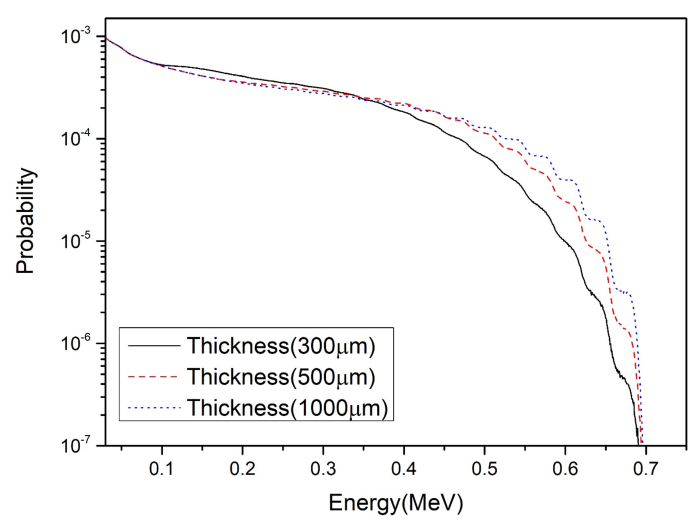

Fig 1. Reaction probabilities according to the thickness of PIPS

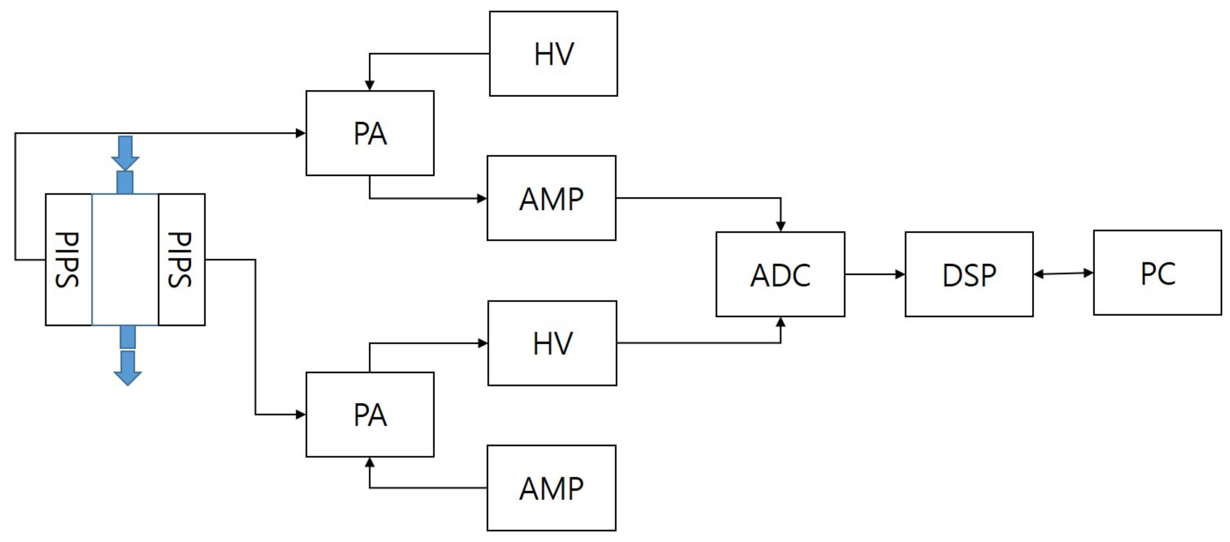

Fig 2. Design of the radioactive krypton detection system using two PIPS Detector

- **The system were designed to evaluate the actual noise and efficiency using both 450 ㎟ and 1200 ㎟ with 500 ㎛ thickness.**
- **It is designed to increase the detection efficiency by configuring krypton gas to pass between two PIPS and We evaluated the efficiency of the system using MCNP.**
- **When the pressure in increased, because the distance between the source and the PIPS is closer, the reaction probability is higher.**
- **The reaction probability can be decreased by the density increase of gas, however, the decrease effect is much smaller than the increase effect by distance decrease.**

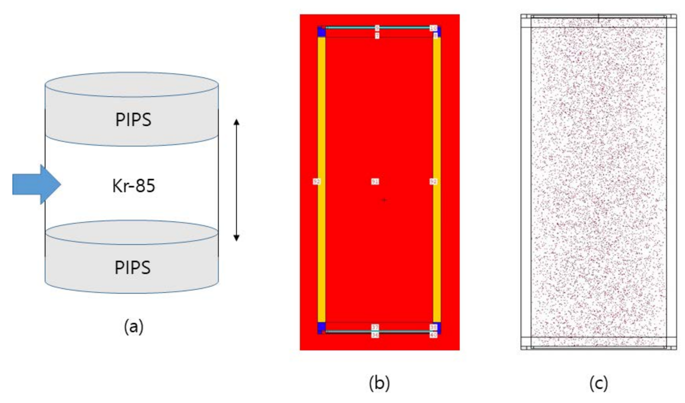

Fig 3. (a) Schematic diagram of the system using two PIPS, (b) The structure using MCNP and (c) the distribution of ^{85}Kr source

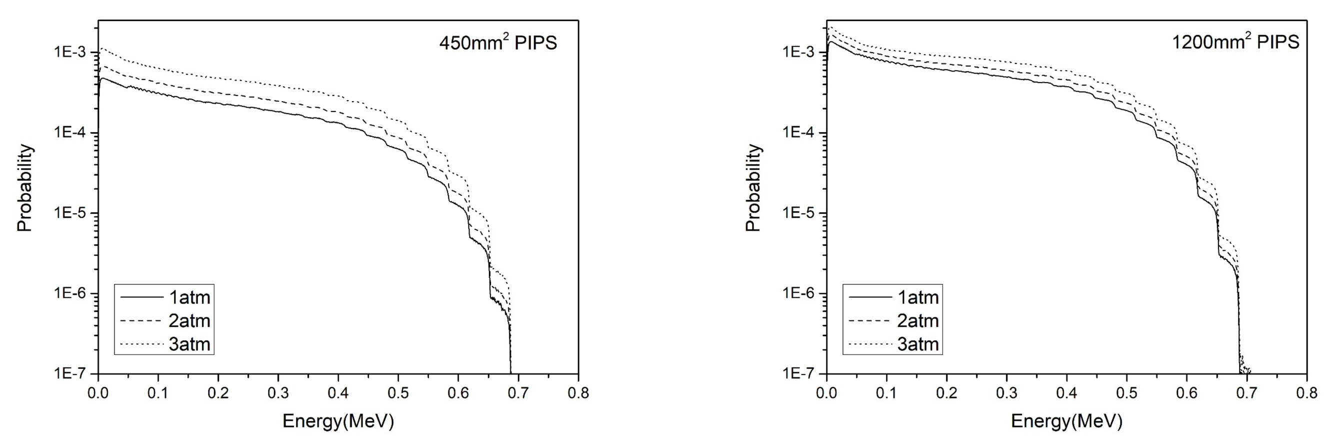

Fig 4. Reaction probabilities of PIPS with an area of 450 & 1200 ㎟ according to the pressure

Result and Conclusion

- **Using PIPS with an area of 450 ㎟, the reaction probabilities are 14.8, 20.1, 31.3 % when the pressure 1, 2 and 3 atmosphere, respectively. Using PIPS with an area of 1200 ㎟, the reaction probabilities are 39.4, 47.1, 58.9 % when the pressure 1, 2 and 3 atmosphere.**
- **From these results, it is appropriate to compose the system of two 1200 ㎟ PIPS and to operate at 3 atmosphere. However, because the noise is high when the arear of PIPS is large, so if the ROI excluding the low energy regions considering noise is set, the actual measurement efficiency will be lower than the simulation results.**
- **In the future, we will make up the system and evaluate the real noise and efficiency.**

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