

§44. R & D of High Sensitive Radiation Detector

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The purpose of this study is to develop a radiation detector of high sensitivity, and to apply that detector to the LHD experiment.

In addition, generally used possibility is pursued.

In conventionally, radiation detectors in which reverse bias is applied to a diode comprising of semiconductors such as silicon or germanium are used for detecting ionizing radiation. Since the energy of radiation is absorbed in a solid part whose density is high, it is expected that the sensitivity is essentially high. However, there is not amplification in itself, and leak current is large. There are some limitation of use, such as cooling it in liquid nitrogen temperature.

For the above-mentioned situation, the element of semiconductor for light detection apparatus has been developed recently, which has function of amplitude own signal. An example is raised in the following. That is an element of a type called avalanche photo diode (APD). In the element, photoelectric effect is occurred as light absorption. This principle is the same as a normal semiconductor detector for radiation. Therefore, it is suggested that APDs has a sensitivity for ionizing radiation theoretically. However, there have been few studies for this application. In this study, gallium/arsenic or indium/phosphorus are also assumed as element material. Because of high atomic number, absorption by photoelectric effect becomes large in different order of magnitude comparing with silicon. Sensitivity of low energy X-ray will be improved as a result.

In addition, sensitivity of high energy gamma ray may become high.

We have a plan of theoretical examination in these elements.

In this year, the silicon -APD for light detection device

was purchased in commercially available. And the performance as radiation detector was tested. The silicon -APD (element size 3mm ϕ) was irradiated with gamma rays, and the signal was detected with an oscilloscope. An output signal of 10 mV was obtained without an amplifier. Figure 1 shows an example of output signal. The energy spectrum of electron which occurred in the silicon was got by radiation transfer calculation as shown in Fig.2. From these experiment, it was cleared up that APD has a performance of radiation detection in high sensitivity.

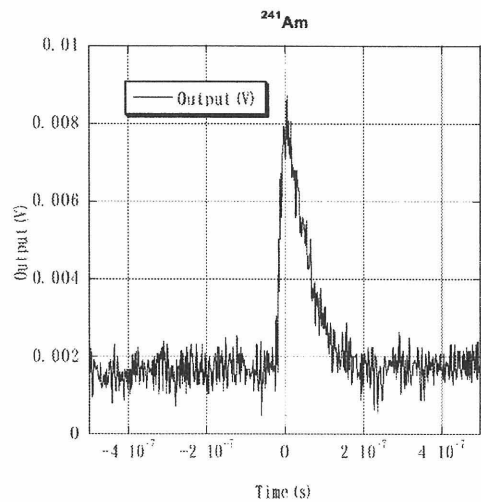


Fig. 1 An example of output signal.
(Am-241, 60 keV gamma-ray)

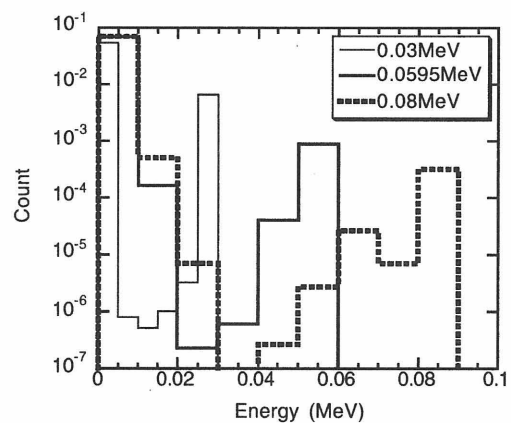


Fig. 2 Simulation result of energy spectrum.