§29. Development of a Three Dimensional Neutron Imaging System Composed of a Metal Grid and Liquid Scintillator

Takada, E., Iwaki, N.
(Toyama National College of Technology),
Kawarabayashi, J. (Nagoya Univ.),
Isobe, M.

The neutrons emitted from the Large Helical Device (LHD) have the information on the slowing process and confinement of the energetic ions. For gathering these information, the parameters on neutrons like their direction information and position distribution should be measured. In this study, fundamental study on a new three dimensional neutron distribution sensor has been studied, where the system is composed of a metal grid structure and liquid scintillator.

For measuring the neutron distribution, we have adopted a metal grid structure as shown in Fig.1. The space between the metal pillars has been filled with liquid scintillator. The scintillation photons produced in the scintillator migrate to the end of the grid structure. During their migration process, reflections on the metal pillar surface and absorption in the scintillator occur, which depress the diffusion of the photons and we can measure the grid channel in which the photons are produced.

In order to measure the three-dimensional distribution, we have assembled the structure into three layers. The size of the each pixels made by the grid was about $4x4x4mm^3$.

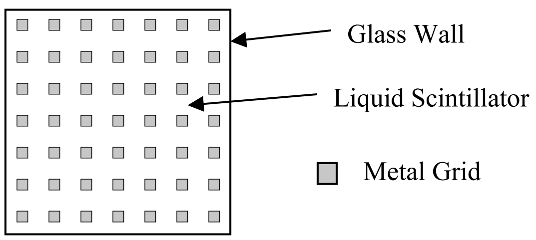

Fig.1 The grid structure used in the present system.

We have carried out the experiments using the Fast neutron source reactor “YAYOI” (Univ. of Tokyo). A fast neutron beam collimated into the diameter of 10 mm was irradiated on to the present system. Here, the sensor was moved along a linear line by a moving stage. Measured count distribution is shown in Fig.2. Although the distribution seems to become broad at the positions away from the center, it can be seen that the system could measure the change of the neutron incident position.

Fig.3 shows the comparison of the measured results between the two cases: in one case the neutron beam was perpendicular to the system and in the other case, the beam was incident on to the sensor with the angle of 20 degrees. It can be seen that, when the beam was not perpendicular to the censor, the peak configurations were different between each layer. This result shows the possibility of the system to measure the average incident angle of the neutrons.

Although there still exists a problem that the system has a larger counting efficiency also for gamma rays, the fundamental possibility of this system has been shown.

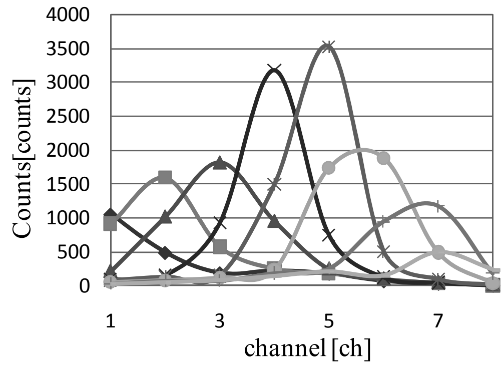

Fig.2 Measured distribution when the fast neutron beam from YAYOI was irradiated with the diameter of 10 mm.

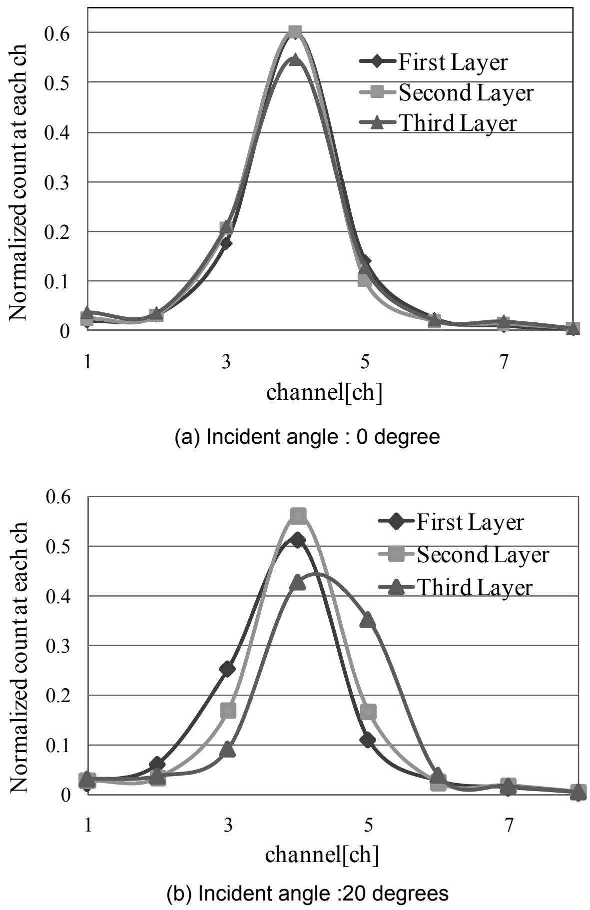

Fig.3 Comparison of the measured distributions between the incident angles were 0 degree and 20 degrees.