I. 12. An Open Experiment of a Submilli-PIXE Camera

Matsuyama S., Ishii K., Yamazaki H., Iwasaki S., Tokai Y., Sugimoto A., Endo H., Ozawa T. and Orihara H.*

Department of Quantum Science and Energy Engineering, Tohoku University
Cyclotron Radioisotope Center, Tohoku University

Introduction

Recent young Japanese generations tend to be not interested in science. One of the reasons is that young people like to take easier subjects. To help understanding nuclear technology or radiation science, we have held an open experiment of PIXE once a year since 1996. Among many scientific experiments, PIXE analysis is one of the most appropriate experiment, because to know what elements are contained in our belongings is the most interesting thing for us and PIXE can easily and quickly analyze them without their deterioration by beam irradiation.

The open experiments of PIXE analysis using a vertical in-air PIXE (ViaPIXE) system\(^1\) were held at a Dynamitron laboratory of Tohoku University\(^2\). Lecture and inspection for the Dynamitron accelerator and the in-air PIXE system were performed in the open experiments. The participants themselves went to the place of the ViaPIXE system and, on a target stage, set their sample which they brought from their houses or elsewhere and then, the sample was irradiated with 3 MeV proton beams. Observing PIXE spectra, we made them to understand the X-ray peaks of the elements which were contained in the sample. The first and second open experiments were held as an event of an open school which has been held during the period of annual meetings of Atomic Energy Society of Japan. After these events, the open experiments were held during the period of an open campus aimed to introduce activities of Tohoku University to high school students. Up to the present, more than 270 people joined the open experiments of PIXE. Most of the participants were impressed into quick and easy elemental analysis by PIXE. This seems to result that the participants felt interest in nuclear technology and radiation science.

A submilli-PIXE camera was recently developed in our laboratory\(^1\) and was introduced in the open experiment. The submilli-PIXE camera can measure spatial distribution of elements. This system consists of a submilli-beam line with a high-speed beam scanning system and a spatial distribution imaging system of elements in the region of 3 cm×3 cm. The submilli-beams are formed by using two slits and are always scanned on an interesting region of the sample. When an X-ray is detected, the X-ray energy and the beam
position are simultaneously measured for each event. This system can display the spatial
distribution image of element even while the data are being collected. By comparing the
measured elemental images with the shape of the sample, the participants may easily consider
meanings of the distribution of elements in the sample. In the submilli-PIXE camera,
samples can be analyzed in atmosphere. This in-air analysis is an important performance for
the open experiments, since we can analyze any sample which participants will bring.

Open experiment

The 4th open experiment of PIXE was held on 29 and 30 July 1999 when the open
campus of Tohoku University was held. We visited junior high schools in Sendai City to
explain the aim of the open experiment of PIXE to science teachers. More than one
thousand people participated in the open campus of Tohoku University. About 400
participants of them visited our department and were advised to participate in the open
experiment of PIXE. We had nine groups (sixty-nine persons). It took about one hour to
perform the open experiment. The participants were led to the Dynamitron laboratory in
every one hour from the main hall of our department, at which our research activities are
exhibited. We gave lectures to the participants for the Dynamitron accelerator, principle of
PIXE and the submilli-PIXE camera using graphic panels. Easy sentences and figures in the
graphic panels were very useful to help understanding of junior high school students. After
an inspection of the submilli-PIXE camera, we received a sample from them and set it
together with them. There were a few participants who offered a sample, since we did not
request them to bring something want to analyze. We considered the belongings of
participants as samples, because the results of analysis might be left in their impression
strongly. In the case that they did not have an appropriate sample, we made them choose
one of the samples which were prepared by ourselves. Before irradiation of the sample, we
showed the beams spots on the beam viewer at the upstream side of the sample position.
Then we pulled out the viewer and irradiated the sample. It is very important to visualize the
beam spot to get their better understanding.

We showed the elements contained in the sample by observing the PIXE spectrum.
At the previous experiments, the participants had been surprised at the PIXE spectrum being
formed in a moment. However, this time, the participants were not so impressed. Since
we too much emphasized spatial distribution of elements, they were not interested in the PIXE
spectrum itself. This point should be reconsidered. We showed the elemental distribution
images for major elements. Samples were school badges, a can of Cola drinks, a magnetic
card, a watch, a necklace, earrings, a sandstone and a ball-point pen. It took only a few
minutes to get elemental images. The participants were strongly impressed in that an
elemental distribution was displayed as an image. The participant who analyzed her school
badge was surprised at the elemental image which corresponded to the shape of character on
the badge. Figure 1 shows the photograph and the elemental images of Ni and Pb in the
school badge. The elemental image of Ni shows very clearly the shape of character in the badge. Since the spatial distribution of elements showed the shape of the sample or the character on the sample, the participants seemed to easily understand nuclear technology and its application.

The participants who joined the open campus tended to visit as many places as possible and their visiting time was restricted to several hours. Nevertheless, twenty percents of the persons who visited our department joined the open experiment of PIXE which lasted one hour. It results that the open experiment of PIXE attracts their interest. Since the open experiment was held during a period of the open campus of Tohoku University, half of the participants were high school students. About ten percents of the participants were junior high school students. At the first open experiments of PIXE held in 1996, junior high school students occupied more than a half of the participants, however, the number of junior high school students decreased. The first open experiment of PIXE was held in the holiday on September 1996, therefore, the rate of junior high school students was high because their teacher accompanied them. In spite of our effort for advertisement of the open experiments of PIXE, junior high school students did not participate so much at the present. Recently, the open experiments were held at the end of July when a summer vacation began. When a summer vacation begins, it may be difficult for junior high school students to participate in the event. To continue to hold the open experiments, we are now considering and seeking an appropriate period when junior high school students can participate easily.

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References

Fig. 1. Photograph and elemental distribution images of Ni and Pb in the school badge.