# Renovation of Ge-crystal monochromator for triple-axis neutron spectrometer AKANE

H. Hiraka, Y. Miyake, K. Ohoyama, Y. Yamaguchi, K. Yamada
*Institute for Materials Research, Tohoku University*

Neutron scattering spectroscopy is a powerful probe to study phonon and magnon excitations in condensed matter physics. Renovation of neutron monochromator, which properly branches monochromatic neutrons from a white beam, is therefore one of the instrumental key issues in neutron science; especially, due to the lack of neutron beam flux. Ge and Si single crystals have been one of the typical components for neutron monochromator, because high-quality and large-size crystals are easily available. However, because of a mismatch between the incident-beam divergence and the small mosaicity coming from perfect crystals, the neutron reflectivity of Ge and Si is severly low and much efforts have been devoted so far to overcome it.

We have tried to introduce mosaic crystals into Ge crystals appropriately by pressing at high temperatures. Eventually, an optimal hot-pressing condition was determined [1,2], so that Ge crystals with a mosaic width of ~0.3 ° and a peak reflectivity of ~40% are well reproduced [Fig.1(a)]. A vertically focusing-type Ge monochromator, which was renewed for a KINKEN triple-axis spectrometer AKANE, is shown in Fig.1(b).

We substituted this renewed monochromator for the previous one on AKANE, and first characterized the beam size of 24w*32h mm2 at the sample position. This area is about 1.5 times as large as the previous one, and the neutron density per area is confirmed to be unchanged. Second, we radiated the monochromatic neutron beam ($\lambda$=2.0 A) onto relatively large samples and measured scattered-neutron intensity. Figure 1(c) shows a comparison of reflected intensity with previous one by using a large sample. The magnetic Bragg reflections are enhanced in intensity by ~60%, as expected from the beam size. Further, a newly supplied second-wavelength mode ($\lambda$=1.3 A) works well for high-energy excitation measurements, as seen in Fig. 1(d). Present renovation not only vitalizes the scientific research on AKANE, but also opens new fundamental techniques on neutron scattering.

References

[1] Y. Miyake, H. Hiraka, K. Ohoyama, Y. Yamaguchi, K. Yamada; J. Phys. (Conf. Ser.), accepted on Sep. 04 in 2009.
[2] Y. Miyake, Master Thesis of Science (Tohoku University, Feb. in 2010).

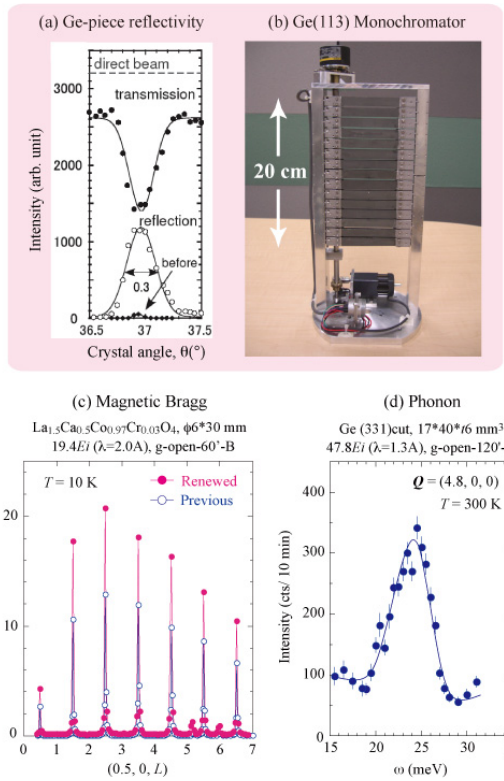


Fig. 1. (a) Rocking curves of Ge piece before and after hot-press. (b) Renovated Ge(113) monochromator. (c) Magnetic Bragg peaks before and after monochromator renovation. (d) Phonon peak under the newly equipped second-wavelength mode.