Measurement of magnetic diffuse scattering from Ni2MnAl

Kouichi Hayashi, Kenji Ohoyama, Tokujiro Yamamoto, and Toetsu Shishido
Insitute for Materials Research, Tohoku University

Neutron holography is relatively local structural analysis method, which visualize 3D local atomic arrangements around selected elements in solids. This technique is attracted as local structural analysis of dopants like X-ray and neutron holography, which have been developed in last two decades. However, the photoelectron or X-ray holography has a disadvantage that they cannot apply to hydrogen system because hydrogen dose not emit any fluorescent X-rays and photoelectrons. In order to overcome this difficulty, neutron holography was proposed in 2001. First demonstration of the neutron holography was realized using a single crystal of simpsonite (Al4Ta3O13(OH)) by Sur et al. They measured angular anisotropy of incoherently scattered neutrons from hydrogen nuclei, and reconstructed surrounded oxygen nucleus images. In 2004, Cser et al. applied this technique to a palladium hydride single crystal, and determined the location of hydrogen in the PdH. We also measured efficiently the neutron hologram of a palladium hydride single crystal using the powder diffrcatometer of HERMES in JRR-3M reactor, and found the thermal diffuse scattering effect in the measured hologram.

Neutron scattering has mainly two ways of scatterings such as nucleus scattering and magnetic scattering. Here, in order to investigate the effect of magnetic scattering on neutron hologram, we measured angular anisotropy of incoherently scatterings by Ni in Ni 2 MnAl single crystal at room temoerature. The present sample shows ferro-antimagnetic property below the Nell temperature of 295 K. The incoherent scattering cross section of Ni was much larger than those of Ni and Al. The single sample of Ni 2 MnAl was grown by floating zone method, its size was 6 mm in a diameter and 5 mm in a thickness. Its microstructure and crystal structure were checked by SEM and TEM, respectively.

Wavelength of the neutron was 0.182 nm. Sample was rotated in the range of 0 - 359 with the step of 1 , where rotation axis was parallel to the incoming beam direction. Neutrons incoherently scattered by Ni nuclei in the sample were detected by HERMES 150 He3 counters at each sample rotation angle. Polar angle of the measured hologram defined by the counter ranged from 7 to 157 . Dwelling time at each angle was 600 sec. The average neutron intensity at each pixel was about 500 counts. Figures 1 show the 2D angular distributions of the neutron intensities around the sample at room temperature and 100 K, respectively. The displayed patterns exhibit strong spots reflecting the sample crystal symmetry, due to thermal diffuse scattering and magnetic diffuse scattering. In order to extract hologram pattern due to pure magnetic scattering, we must measure holograms of Ni 2 MnAl at different temperatures above and below the Nell temperature of 295. Further analysis is now in progress.

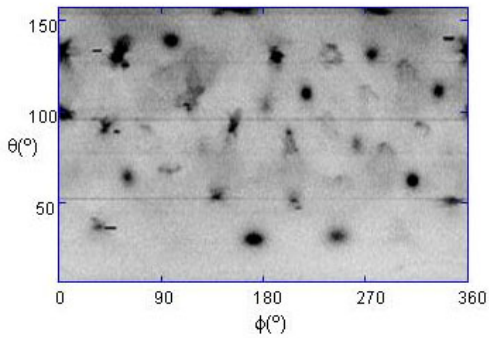

Fig. 1. Fig. 1 2D distributions of neutron intensities around Ni2MnAl.