NE-3/2003G161

Nuclear Resonant Small-Angle Scattering of FeB Alloys

Yasuhiro KOBAYASHI[*1], Makoto SETO[1], Shinji KITAO[1], Ryo MASUDA[1], ZHANG Xiaowei[2], Norimichi KOJIMA[3], Masaya ENOMOTO[3], Yuuki ONO[3]
[1]Research Reactor Insttute, Kyoto University, Kumatori, Osaka 590-0494, Japan
[2]KEK-PF, Tsukuba, Ibaraki 305-0801, Japan
[3]Graduate School of Arts and Science, University of Tokyo, Meguro, Tokyo 153-8902, Japan

Introduction

The nuclear forward scattering (NFS) is powerful technique to measure the hyperfine fields of the nuclear. On NFS measurement, we can use the X-ray optical technique. It is the advantage over the other hyperfine field measurement techniques. On this study, we used small-angle scattering technique with NFS. From the nuclear resonant small-angle scattering, we can obtain the information of the hyperfine field from the specific size scattering material [1].

Experimental Procedure

The experimental arrangement is shown in Fig. 1. It is typical setting of Bonse-Hart camera. The energy of the synchrotron radiation was tuned into 14.4 keV and monochromatized into 6.4 meV width by the high-resonance monochromator. The angular profiles were measured by the rotation of second Si111 crystal. The photons were detected by the Avalanche Photo Diode (APD), which is fast X-ray detector.

The sample was $Fe_{80}B_{20}$ amorphous ribbon annealed in 0.2 hours at 450°C to precipitate small crystals. For sample preparation, we used ^{57}Fe 98% enriched iron.

Results and Discussion

The observed time spectra at forward position (0 μrad) and small-angle position (40 μrad) are shown in Fig. 2. These spectra show quantum beats. The quantum beat is due to the hyperfine magnetic fields at the Fe nuclear, and the beat changes with the direction of the magnetic moments. The obtained directions of magnetic moments are in sample plane at forward position, and perpendicular to sample plane at small-angle position. Applying the external magnetic field (0.35 T) to the sample, the time spectra shows same beat at forward and small-angle (no figure), and magnetic moments are parallel with external field. This result shows that the unusual direction of the magnetic moments observed at the small-angle position is due to the magnetic domain structure of the sample. The observed small-angle scattering is probably caused by Bloch type domain wall.

References

[1] Yu. V. Shvyd'ko et al., Phys. Rev. B, 54, 14942 (1996).

*ykoba@rri.kyoto-u.ac.jp

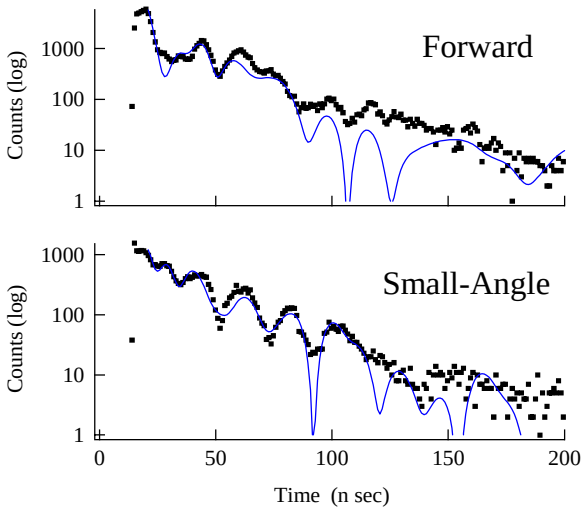

Fig. 2. Time spectra of 450°C annealed $Fe_{80}B_{20}$ amorphous at (a) forward position and (b) small-angle position (40 μrad).

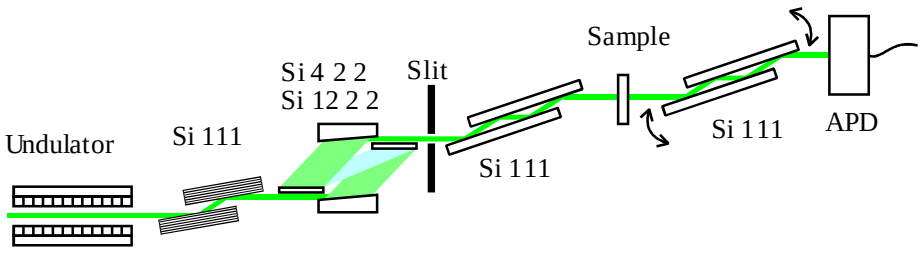

Fig. 1. Schematic drawing of experimental arrangement. Components are not in scale.