Nuclear Resonant Scattering of Ferromagnetic Amorphous Ribbon

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Highly intense synchrotron radiation can make it possible to search the nuclear resonant scattering of nuclei in various kinds of materials. In this investigation, we have performed nuclear resonant scattering of ^{57}Fe nuclei in a ferromagnetic amorphous ribbon. Motivations of tthe present investigation are as follows: (1) Ferromagnetic amorphous ribbon does not have a long-range atomic order, but a long-range magnetic order creats hyperfine magnetic field and their magntidue shows a broad distribution. Static hyperfine fields at nuclei are origin of the quantum-beat in the delayed time spectrum obtained by the nuclear resonant forward scattering (NFS). The existence of the distribution of the hyperfine fields may affect on the shape of the time spectrum. (2) Electric scattering of an amorphous shows a well known Halo in diffraction pattern due to the lack of its long-range translational symmetry. We can expect the nuclear Halo pattern in nuclear resonant scattering as an analogy of the electric scattering. (3) Generally a ferromagnetic amorphous ribbon shows a spin-texture, especially in-plane spin-texture. Since the synchrotron radiation is linearly polarized, the NFS depends on the direction of the magnetic moment and it is possible to analyse the spin-texture by its directional dependence. (4) Vibrational states of an amorphous can be eluciated by the nuclear inelastic scattering of the probe nuclei.

Hard X-ray from an in-vacuum undulator was monochromatized by a standard double-crystal monochromator and further monochromatization was performed by using Si 522 - Si 975 channel-cut monochrmator whose energy band-width is approximately 2.5 meV. Specimen was a ferromagnetic amorphous ribbon $(Co_{0.94}Fe_{0.06})_{74.5}Si_{13.5}B_{12}$. NFS was measured by using a Si avalanche photo diode. Beam-line was operated by 21 bunch-mode and the time intervals of the bunch were 228 ns. Figure 1 shows two typical time-spectra of the nuclear forward scattering at room temperature obtained from a ferromagnetic amorphous ribbon $(Co_{0.94}Fe_{0.06})_{74.5}Si_{13.5}B_{12}$ whose thickneass is 140 μm. *R* is the longitudinal direction of the ribbon and *E* is the direction of the electric vector of the synchrotron radiation. Clearly the directional dependence was found and suggest the existence of the spin-texture within the ribbon plane. Further analysis and experiments to aim (2) and (4) are in progress.

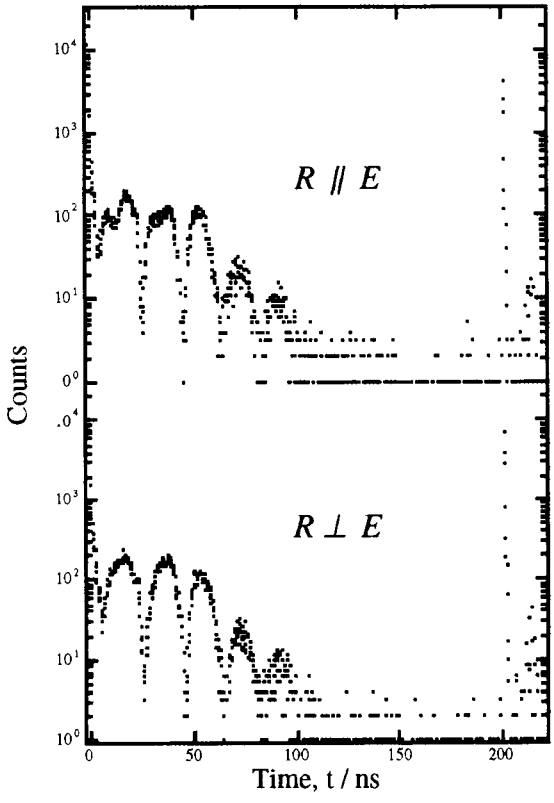

Figure 1. Typical time spectra of NFS obtained from a ferromagnetic amorphous ribbon, $(Co_{0.94}Fe_{0.06})_{74.5}Si_{13.5}B_{12}$.