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Phonons in PtFe thin films as a high-density magnetic recording media

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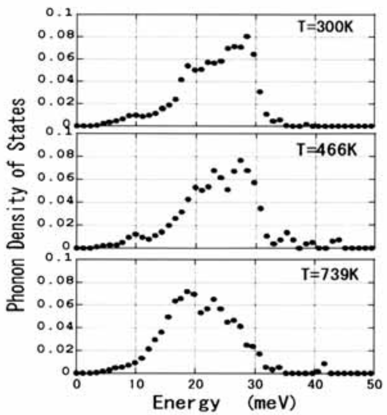
An $L1_0$(AuCu) type PtFe alloy is considered to be an excellent candidate of the high density perpendicular magnetic recording media. Recently, present authors found that the tetragonal lattice distortion (1- c/a) of the PtFe alloy increases with increasing temperature up to 750 K. The origin of the increasing tetragonality at high temperature was studied through the phonons of Fe atoms.

Samples of PtFe alloys with both bulk crystal and thin film were prepared. PtFe thin film was deposited on MgO single crystal substrate and piled up to 50 PtFe layers. Temperature variation of the phonon DOS was studied using the nuclear resonant inelastic scattering method at the BL11UX.

The phonon DOS for the PtFe thin film was first studied. Since the natural Fe was used for the thin film, the statistics of the data were too poor due to the small abundance of ^{57}Fe in the thin film. Thus, temperature dependence of the phonon DOS in the PtFe alloy was studied using the bulk specimen at 300 K, 466 K and 739 K and the results are given in the figure. The phonon DOS for 300 K and 466 K are very similar, but that at 739 K shows drastic changes. There are no reports of the structural phase transition at any temperature for this system. The chemical order-disorder transition is reported to be 1570 K. Thus, the phonon anomaly is not due to the atomic disorder. We speculate that the electronic configuration of the Fe atoms show drastic changes around this temperature.



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Study of Iron Storage Process in Ferritin by Nuclear Resonant Scattering

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Ferritin is an iron-storage protein, which plays the main part of iron metabolism in a human body. One ferritin molecule holds iron atoms in itself up to 4500. Since the size of iron cluster in the ferritin molecule is limited in the size of the packed area, it is also noticed as the remarkable molecule to produce the size-defined nanoparticles.

To reveal the storage system of this protein, we prepared several samples which contain different numbers of iron atoms in a ferritin molecule. Nuclear resonant scattering, the method we chose, is a useful method to get information on the dynamics of specific element in a compounds such as iron atoms in ferritin.

The measurements were performed at BL11XU. The storage ring was operated in a 11-train*29-bunch mode in which the interval of the bunches is suitable for the ^{57}Fe nuclear excitation.

Figure 1 is a nuclear resonant scattering spectra of ferritin. There are 2630 and 980 iron atoms in one ferritin molecule of sample A and sample B respectively. Phonon density of states were observed in the spectra.

Further analysis is undertaken.

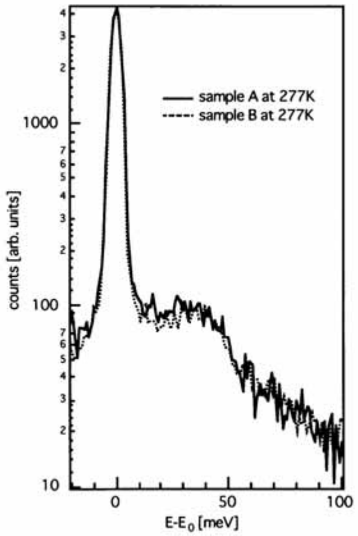

Fig.1. (a) The solid line shows the nuclear resonant scattering data from sample A and the broken line shows those from sample B. Both data are taken at a temperature of 277 K.