Long-time variation of magnetic structure in a multistep metamagnet CeIr3Si2

K. Motoya, Y. Muro and T. Takabatake (a)
Tokyo University of Science, (a) Hiroshima University

Time variation of magnetic property has been extensively investigated in the spin-glass study. In a system without randomness or imperfections we have not thought to observe a time variation of magnetic structures in an attainable time scale. We report the first observation of a long-time transformation of magnetic structures in a non-diluted magnet $CeIr_3Si_2$.

A ternary compound $CeIr_3Si_2$ shows successive magnetic transitions at T_{N1}=4.1 K and T_{N2}=3.3 K. At $T < T_{N2}$ it shows three-step metamagnetic transitions below H=1.43 T.[1,2] When a sample is rapidly cooled below T_{N2}, the magnetic Bragg peaks corresponding to the medium temperature (MT) phase ($T_{N2} < T < T_{N1}$) are observed. The amplitude of these Bragg peaks gradually decreases as time goes on. On the other hand, another group of Bragg peaks corresponding to the low temperature (LT) phase ($T < T_{N2}$) gradually grow with time. Figure 1 shows the time variations of the amplitudes of the MT and LT phase signals measured at various temperatures. At T=0.7 K the MT-phase signal was observed without detectable change up to 10 h and no LT phase signal was observed.

The time variations of the signal amplitude are well expressed by simple exponential functions with a characteristic time t^*. The value of t^* for each measurement is posted in the figure. We analyzed the temperature variation of t^* in terms of the Arrhenius model. The activation energy of the time variation was obtained as E_a/k_B =4 K.

Although the magnetic structure in each phase has not been determined, we presume that the transition from the MT phase to the LT phase is basically an incommensurate to commensurate phase transition. We note that in the present measurements, only the amplitude of Bragg peaks varied with time. Neither the position nor the line width of Bragg peaks showed appreciable time variation. These results strongly suggest that we have observed the change of the volume fractions of two magnetic regions with a commensurate and an incommensurate structures.

We believe this is the first real-time observation of magnetic structural change in a uniform magnetic system. In future experiments with high intensity apparatus, we will be able to observe the change of domain size at very early stage of the time evolution.

References

[1] Y. Muro et al.: J. Mag. Mag. Mater. **310** (2007) 389.
[2] K. Shigetoh et al. : Phys. Rev. B **76** (2007) 184429.

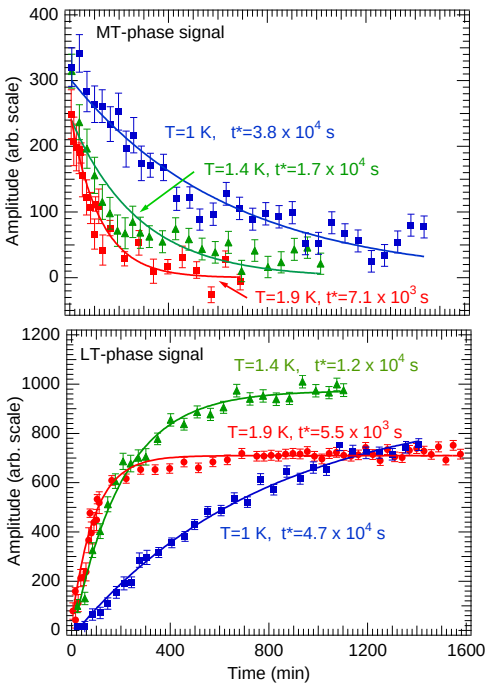

Fig. 1. Time variations of the amplitude of the MT and LT phase signals at various temperatures.