Successive metamagnetic behavior in an easy-plane type antiferromagnet ErNi2Ge2

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A rare earth intermetallic compound ErNi2Ge2 with a tetragonal ThCr2Si2-type structure is a long-period antiferromagnet with TN =3.0K and magnetic wave vector km=(0,0,0.75). Our recent magnetization measurements by using single crystalline samples and crystalline-electric-field (CEF) analysis indicate that ErNi2Ge2 is an easy-plane type magnetic anisotropy, where the c-plane is a magnetic easy-plane. Interestingly, a successive metamagnetic behavior has been found in a magnetization process along the magnetic hard-axis, c-axis. Such a metamagnetism along a magnetic hard-axis had also been found in another easy-type anitferromagnet TbB4, which has the Shastry-Surthreland lattice. Recently, the multi-step metamagnetic transition in TbB4 had been explained based on a model with a XY-type ground spin state and an Ising-type exited spin state[1]. Now we are trying to understand the metamagnetism in ErNi2Ge2 based on a similar model.

On the othre hand, a colinear sinusoidal modulated magnetic structure of ErNi2Ge2 was reported by Andre et al. [2], where the Er magnetic moment forms an angle 64 degree with the c-axis. In their model, the c-axis component of the Er magnetic moment is about half the size of the c-plane component, contradicting the results of our magnetization measurements mentioned above. In order to determine the direction of Er magnetic moment in the antiferromagnetic state, we performed polarized neutron scattering experiments by using a single crystalline sample on the triple-axis spectrometer 5G installed at JRR-3M reactor.

Figure 1 shows spin-flip (SF) and non-spin-flip (NSF) magnetic scattering profiles with a scattering vector K = (2,0,0.75) in the condition of the polarization vector of neutron P being perpendicular to the scattering vector. In this experimental condition, the direction of P or K is almost parallel to the c- or the a-axis respectively, and hence, the b- or the c-axis component contributes the SF or the NSF scattering respectively. As shown in Fig. 1, the NSF scattering is almost absent, indicating the c-axis component is almost 0. Hence, we have concluded that ErNi2Ge2 is the easy-plane type antiferromagnet, as expected from the magnetization measurements.

[1] T. Inami et al., cond-mat/0709.0977.
[2] G .Andre et al., J. Alloys and Comp. 224, 253 (1995).

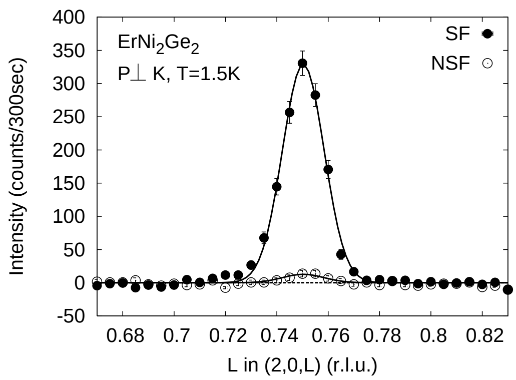

Fig. 1. Magentic scattering profile of polarized neutron at the magnetic wave vector K = (2,0,0.75) in the condition of the polarization vector P being perpendicular to K. Closed and oped circles denote the SF- and the NSF-scattering profiles respectively.