



ESRF

	Experiment title: XMCD investigation of magnetic phases in SmMn_2Ge_2	Experiment number: HE-754
Beamline: ID12A	Date of experiment: from: 02/02/00 to: 08/02/00	Date of report: 29/02/00
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Names and affiliations of applicants (* indicates experimentalists):

SUZUKI Hiroyuki*
SCHMITT Denys*
GALERA Rose Marie*

Laboratoire Louis Néel, CNRS,
BP166 38042 Grenoble

Report:

SmMn_2Ge_2 shows complex phase diagram, i.e. three phase transitions are successively observed at $T \approx 348$ K (FM1), $T \approx 150$ K (AFM1c) and $T \approx 100$ K (FM2c). The direction of the net ferromagnetic component of the Mn moments changes from the c -axis in FM1 and AFM1c phases to the a - b plane in FM2c phase, whereas its magnitude remains almost constant. The FM1-AFM1c transition is driven by the thermal contraction of the lattice on cooling. On the other hands, the origin of the AFM1c-FM2c transition, reentrant ferromagnetic transition with the change of the direction of the ferromagnetic component, is not clear. In FM2c phase, a ferromagnetic arrangement of the Sm moment ($\mu = 0.65 \mu_B$ at 1.5 K) along the a direction was found. In AFM1c phase, however, the refinements of the structure show no existence of a Sm moment, while it is indicated that there may be a Sm moment of around $0.6 \mu_B$ in FM1 phase. The aims of this experiment were to reveal the existence of the Sm moment in AFM1c phase and to study the origin of the reentrant ferromagnet ordering by performing the XMCD selectively on the three phases and also selectively at the Sm $L_{2,3}$, the Sm $M_{4,5}$ and the Mn $L_{2,3}$ edges.

Out of the proposed shifts for ID12A and for ID12B, the beam time only for ID12A was allocated for this time. In this report, we present the results obtained from the XMCD measurements in ID12A only at the Sm L_3 edge of single crystals of SmMn_2Ge_2 .

Because the Sm L-edges ($E \sim 6.7$ keV) locates just above the Mn K-edge ($E \sim 6.5$ keV), the XMCD spectra are polluted by the EXAFS (magnetic and non-magnetic) from the Mn K-edge.

The main results of the measurements performed with the field applied parallel to c -axis.

- i) In the FM1 phase, a XMCD signal is observed at the Sm L_3 edge. This signal exhibits mainly a positive peak centered at the absorption edge. This result confirms that Sm bears a magnetic moment in this phase.
- ii) No significant XMCD signal can be measured in the AFMc1 and FMc2 phases.

With the field applied parallel to c -plane.

- i) No signal is observed in FM1 phase as expected
- ii) In the FMc2 phase, a rather well resolved XMCD signal is measured. It presents a three-peak structure: one positive peak at about 10 eV below the edge, one negative peak almost centered at the edge and a positive peak at 3 eV above the edge. This results is in agreement with previous neutron results.
- iii) In the AFMc1 phase, we observe a very small XMCD signal, which seems to have the same structure as that in FMc2 phase. However, the high level of the background dose not allow to definitively conclude and experiments at the Sm $M_{4,5}$ edges are necessary.

The analysis of the present experiments has still not been performed. But some results appear very strange like the inversion of the sign in the XMCD signal between the FM1 and FMc2 phases and also the apparent change in the structure. It is then important to observe the evolution of the XMCD spectra between the FM1 and FMc2 phases at the Sm $M_{4,5}$ edges.

