ESRF	**Experiment title:** XANES and XMCD studies of a new magnet $Mn_{0.25}Rh_{0.75}Ge$	**Experiment number**: HC-2090
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Report:

Our main goal was to understand better the nature of local magnetism of constituent elements of $Mn_{1-x}Rh_xGe$. We planned to measure XANES and XMCD spectra at the $L_{2,3}$-edges of Rh for evaluation of the magnetic moment of Rh, and at the K-edges of Mn and Ge for studying the polarization of 4p electrons.

MnGe is crystallized in noncentrosymmetric cubic structure of the B20 type and has a high temperature of antiferromagnetic ordering, T_N = 170 K. Below T_N MnGe displays a helical magnetic order, the pitch of which decreases with temperature lowering [1]. The magnetic structure can be changed by replacing Mn with nonmagnetic Rh. Increasing the concentration of Rh in $Mn_{1-x}Rh_xGe$ to 40 at. % (x = 0.4) leads to a suppression of antiferromagnetic transition, and above 50 at. % (x = 0.5) $Mn_{1-x}Rh_xGe$ demonstrates a ferromagnetic behavior. For this reason, for studying induced magnetic moments of Rh and Ge we have chosen samples with a large content of Rh, namely $Mn_{1-x}Rh_xGe$ with x = 0.5, 0.75 and 0.99, although initially it was planned to investigate only the sample with x = 0.75. All these samples are characterized by the Curie temperature T_c = 150 K, and their magnetization changes from approximately 0.9 μ_B/f.u to 0.01 μ_B/f.u. Such magnetic behavior allows us to study the dependence of induced moments of Rh and Ge on the total sample magnetization.

All measurements have been carried out in helium cryostat in strong magnetic field applied along the direction of the incident beam (at the temperature 10 K and the magnetic field 2 T for samples with x = 0.5 and 0.75, and at 2 K and 9 T for the sample with x = 0.99).

Measured XANES and XMCD spectra (without the self-absorption correction) at the K-edge of Mn, L_3-edge of Rh and K-edge of Ge are given in figures 1, 2, and 3, correspondingly.

We ascribe the features in the Mn K pre-edge XMCD spectrum to a mixing between Mn 3d and 4p states. A small change of the integral intensity of the XMCD signal implies a small orbital moment of 4p electron states of Mn, because the integral of the XMCD signal at the K-edge is proportional to the orbital magnetic moment [2]. Since the XANES sensitivity to 1 % of Mn ions is marginal, we have not performed measurements for the x = 0.99 sample.

Fig. 2 shows the XANES and XMCD spectra for the L_3-edge of Rh taken for all three samples. We were not able to obtain spectra at the L_2-edge of Rh due to strong diffraction effects at these energies (~3.16 KeV). Because of this, we could not determine the value of the induced magnetic moment of Rh caused by the magnetization in the presence of magnetic sites of Mn. However, the observed polarization at the L_3-edge of Rh demonstrates a certain relation with the value of magnetization for the x = 0.5 and x = 0.75 samples. For $Mn_{0.01}Rh_{0.99}Ge$ the polarization at the L_3-edge of Rh is practically absent.

XMCD spectra for the K-edge of Ge with first negative peak (see Fig. 3) indicate that in the x = 0.5 and 0.75 samples there is a significant polarization of 4p electrons, which depends on the total magnetization. The same sign of the XMCD K-edge signal for Mn and Ge implies that moments of 4p electrons are possibly co-align. In $Mn_{0.01}Rh_{0.99}Ge$ with the magnetization close to zero, the polarization of Ge 4p-electrons is not observed.

A publication based on the presented XANES, XMCD data and measured magnetization in the magnetic field up to 9 T is in progress.

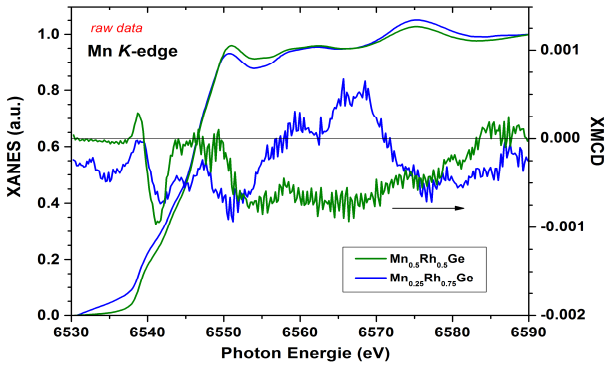

Fig. 1. Mn K-edge XANES and XMCD spectra, measured at 10 K and 2T.

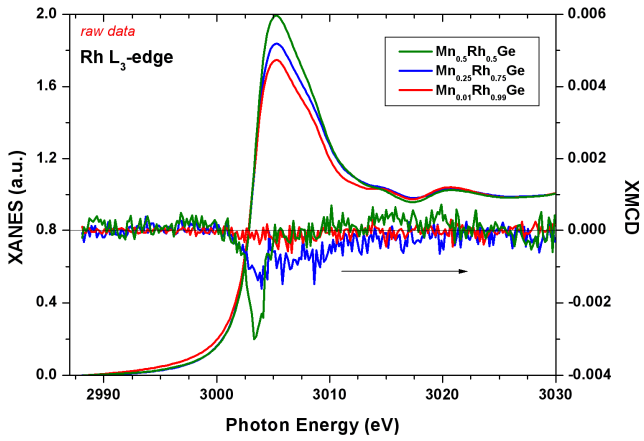

Fig. 2. Rh L_3-edge XANES and XMCD spectra, measured at 10 K and 2 T. $Mn_{0.01}Rh_{0.99}Ge$ measured at 2 K и 9 T

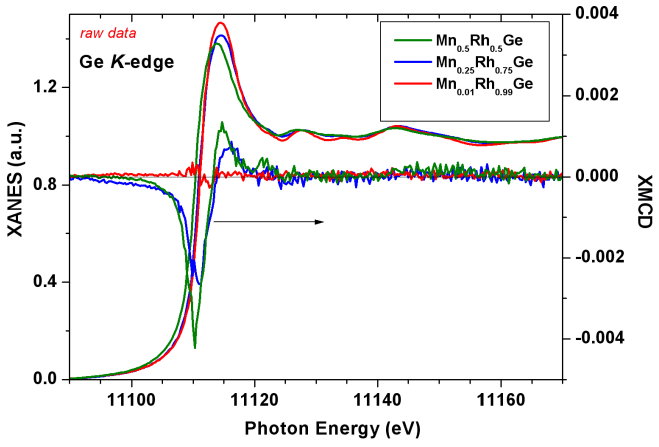

Fig. 3. Ge K-edge XANES and XMCD spectra, measured at 10 K and 2 T. $Mn_{0.01}Rh_{0.99}Ge$ measured at 2 K и 9 T

References:

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2. S. Pizzini, A. Fointaine, PRL **74**, 1470 (1995).