ESRF	**Experiment title:** Spin polarons in EuO films epitaxially integrated with silicon and YSZ	**Experiment number:** MA-3167
Beamline: ID12	**Date of experiment:** from: 12/04/2017 at 08:00 to: 18/04/2017 at 08:00 **Session cancelled due to technical problems on the beamline.**	**Date of report:** 8 September 2017 **Received at ESRF:** 8 September 2017
Shifts: 18	**Local contact(s):** Dr. Andrei Rogalev	

Names and affiliations of applicants (experimentalists):

Dmitry Averyanov[1], Vyacheslav Storchak[1]

[1]*National Research Center "Kurchatov Institute", Kurchatov Sq. 1, 123182 Moscow, Russia*

Report:

We note that our first experimental session (from 21 October 2016 till 27 October 2016) has been cancelled due to regular technical problems on the beamline with the PSS system. Experiment has been carried out in April 2017. During this period we managed to complete the entire experimental program: measure XANES spectra and XMCD signal at both Eu and Gd L2,3 edges on six samples [3 samples EuGdO/Si and 3 samples EuGdO/YSZ] with different doping level in a wide temperature range from 2K up to 300K below and above the transition temperature.

Element-specific measurements have been carried out using XANES and XMCD techniques in a magnetic field up to 17 T. The APPLE-II undulator and a Si(111) double crystal monochromator were used to collect the spectra at the respective energies. The XANES spectra have been recorded using the total fluorescence yield mode in a backscattering geometry. XANES scans were recorded with opposite helicities of the incoming circularly polarized X-ray beam (at 15 degrees grazing incidence with respect to the film surface) with a magnetic field set parallel to the x-ray wavevector. Their direct difference gives an XMCD spectrum.

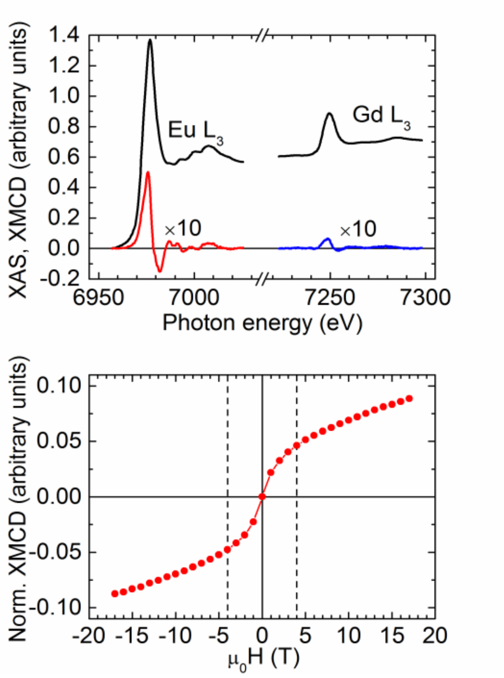

Figure 1. a) XAS signals (black) for L_3 edges of Eu and Gd in a EuO film doped with 15% of Gd measured at 140 K, and the corresponding XMCD signals (red for Eu and blue for Gd) in a magnetic field of 17 T. b) The dependence of the normalized XMCD signal on the magnetic field.

The magnetization curve demonstrates the superposition of the ferromagnetic and the paramagnetic signals in the paramagnetic state (SQUID-measured T_c = 125.5 K). The ferromagnetic signal indicates the formation of magnetic polarons (MP) localized at the Gd atom. The information on MPs comes from magnetic field dependence of the XMCD signal. Figure 1b plots it for the L_3 edge of Eu in $Eu_{0.85}Gd_{0.15}O$ at 140 K, well above T_C. The field dependence is essentially non-linear. This fact clearly indicates the presence of FM regions in the paramagnetic phase, the prime suspect being the magnetic polaron. The FM saturation at around H = 4 T enables extraction of the aggregate magnetic moment M_{MP} of the magnetic polaron using $M_{MP} H \sim kT$ to estimate $M_{MP} \approx 50\ \mu_B$. Assuming that a Eu^{2+} ion provides 7 μ_B into the aggregate MP magnetic moment, this value corresponds to small MPs, involving the first coordination sphere of 6 Eu ions around the carrier plus the contribution of the wave function tails on the more distant ions.