ESRF	**Experiment title:** *Polarized XAFS study on the ion irradiated $Me_1/Co/Me_2$ (where Me_1,Me_2=Au,Pt) structures exhibiting perpendicular magnetic anisotropy*	**Experiment number**: HC1584
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Report:

The thin film structures with perpendicular magnetic anisotropy are promising candidates for the applications as ultrahigh density magnetic storage, fast memory devices and nanosensors. The oscillatory behavior of the magnetization orientation driven by Ga^+ ion irradiation has been already found in Pt/Co/Pt sandwiches [1]. It seems to be rather a simple method to tune magnetic anisotropy in order to obtain two out-of-plane magnetization branches induced by Ga^+ ion irradiation fluence F in a function of a cobalt thickness d_{Co}. The EXAFS investigations on the Pt/Co/Pt layers revealed that a medium Ga^+ irradiation fluence (branch 1) causes a large distortion in the Co film structure which induces perpendicular magnetic anisotropy [2]. However, changes in structural properties connected with fluence increase and/or replacement of Pt layers with other noble metals (e.g. Au) are not well experimentally studied. It was observed that the replacement of upper covering Pt layer with Au leads to dramatic change of magnetic properties map. The branch 1 becomes weaker while branch 2 is stronger in Pt/Co/Au in comparison to Pt/Co/Pt. Increase of coercivity field in Co ultrathin films covered by Au/Pt layers (in comparison with pure Au or Pt coverage) is a promising observation [3] for investigation of Co with different Au and Pt surroundings. Both noble metals, Pt as well as Au, used as neighboring layers stimulate the appearance of perpendicular magnetic anisotropy for ultrathin cobalt films.

We focused our investigations on the (sapphire)/Me_1/Co/Me_2 trilayers, i.e. three series of the samples: Pt/Co/Au, Au/Co/Pt and Au/Co/Au grown by the MBE method on the sapphire single crystal substrate and irradiated with the Ga^+ ions. For each configuration we had chosen subsequent samples: without irradiation as a reference and irradiated with 2 different doses, for which the out-of-plane magnetization of the sample reaches local maxima. The thicknesses of the layers were as follows: Me_1 = 20 nm, Co = 3 nm and Me_2 = 5 nm. The EXAFS and XANES measurements at the Co K-edge were gathered in a fluorescence mode at 77 K in a normal incidence configuration.

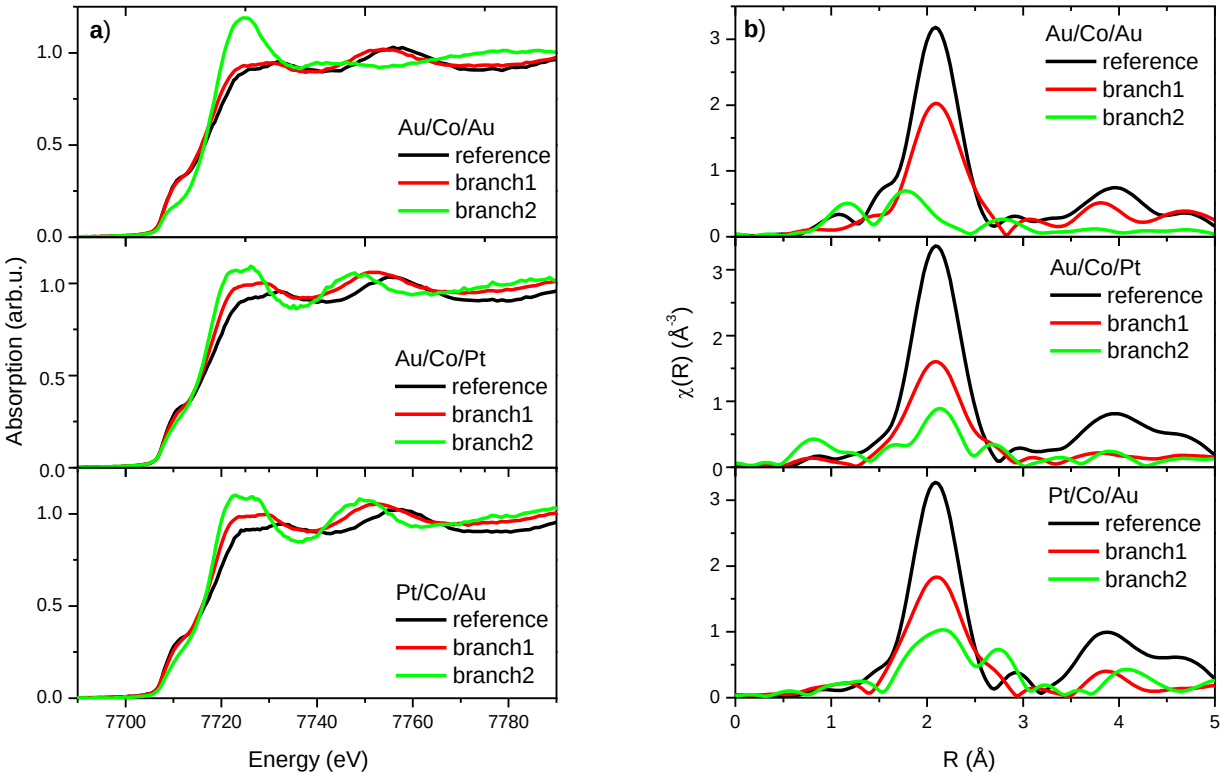

Fig.1. a) Normalized XANES spectra for the investigated $Me_1/Co/Me_2$ trilayers; b) FT EXAFS for the same trilayers.

The comparison of three reference samples reveals that the atomic structure around the Co atoms seems do not depend on the type of the $Me_{1,2}$ layers. The XANES spectra (Fig. 1a) as well as EXAFS (Fig. 1b) show the same features. Moreover, the parameters of the EXAFS fitting are similar within an error.

The irradiation process causes visible changes in the spectra. The evolution of the XANES spectra for the irradiated Pt/Co/Au samples corresponds to the evolution of the Au/Co/Pt set. Shapes of the XANES spectra for the Co, CoPt and $CoPt_3$ models calculated with FEFF8.4 reveal the same tendency as the experimental modified spectra. Therefore, we conclude that this kind of evolution of the spectra can be connected to the increased number of the Pt neighbors in the first coordination sphere of the Co atoms. Preliminary EXAFS analysis also confirmed that in the first coordination sphere number of the Pt (or Au) atoms is increased.

Some differences can be seen in the spectra in case of the Au/Co/Au modified samples. In the sample irradiated with lower Ga^+ dose (branch 1) EXAFS analysis confirmed that the Au atoms became visible in the first coordination sphere just like for the branch1 samples in the other series. However, the samples irradiated with higher Ga^+ dose (branch 2) reveals completely different type of spectrum. XANES and EXAFS analysis revealed that there is a high amount of the cobalt oxides in the sample.

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