ESRF	**Experiment title:** Variations of electronic properties of the invar $PtFe_3$ with temperature studied by XMCD spectroscopy.	**Experiment number:** HE-499
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Report:

Element selective XMCD carried out under pressure is a direct way to evaluate the induced magnetism of 5d elements hybridized with a magnetic 3d element. The strength of the spin hybridization is controlled by the inter-atomic distance.

Among the 3d-5d alloys, the PtFe Invar alloy was the first choice since its temperature dependent magnetic state is known to just compensate the regular temperature induced volume expansion (INVAR).

Despite the low intensity available at LURE (ORSAY) in the range of 11-13 keV, we have been able to collect significant results to identify:

1- the two pressure-induced magnetic transitions in the $Fe_{72}Pt_{28}$ alloy, the Pt atom being a probe revealing the three magnetic states of Fe.

2- the role of the distance-dependent PtFe hybridization to spin-polarize the Pt atoms.

The first idea of carrying out experiments at ESRF was to focus the ESRF experiment on the Fe K edge to separate the two contributions of the Pt XMCD signal, namely the changes of the magnetic state of iron (high spin state to low spin state and then the non magnetic one) and the increasing hybridization which tends to reduce the decrease of Pt spin polarization induced by Fe. The first attempts to carry out XMCD under pressure at K-edges of the 3d elements at ESRF failed essentially for three reasons.

1- The coherent beam of an undulator at ESRF impinging any object inserted in the beam path, including the sample, creates a speckle pattern. This speckle pattern results in derivatives of large amplitude acting as an amplifier to beam instabilities.

2- The first samples used were small crumbs of alloys, which are dramatically good to generate speckles.

3- The beam stability was not good enough for this type of experiment even if classical XMCD has been performed successfully with homogeneous thin foils.

Progressively three improvements have been implemented:

1- Thanks to the machine division an horizontal feedback has been installed on ID24 which gives us dramatic improvements of the stability of the beam, horizontally and vertically - better than a ten times reduction of the spectral density of the beam position.

2- Focus horizontally thanks to the bent Si crystal and also vertically with the first mirror. Samples are single flakes fitting the hole of the gasket of the high-pressure cell.

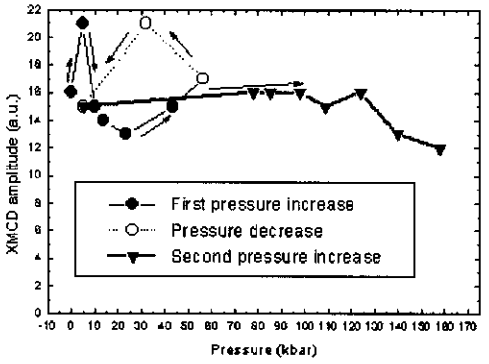
3- The Turbo-Exafs option developed by Sakura Pascarelli and Thomas Neisius should allow the sensitivity to sample-induced speckles to be reduced down to zero.

Herein we report preliminary results on Pt-L alloys chosen for the following reasons.

- *Disordered Pt_3Co*: To investigate the hybridization induced magnetism of Pt at 300K, it is required to keep a high value of Curie temperature (Pt_3Co) which is not the case of Invar $PtFe_3$ ordered phase where both the decrease of the Curie temperature and the Pt-Fe hybridization plays opposite role to determine the Pt XMCD signals. The first series of Pt-L_3 XMCD of Pt_3Co shows an initial increase of Pt-L_3, which can be due to an increasing spin polarization on 5d platinum band induced by the increasing hybridization with the 3d Co band. After 10 kbars there is a slow decrease of the signal which is reduced by half at 280 kbars, which was the highest pressure, accessible with the presently diamond anvil cell preparation. It will be possible to obtain higher pressure with a smaller gasket hole in the high-pressure cell.
- Pt_3Cr: The paper of W. Grange et al (*J. Sychrotron Radiation* 1999), Maruyama et al. (JMMM 1995, **140-144**, 43-44), reports on the magnetism of Pt which is very unusual: L_3 and L_2 edges XMCD have the same sign, meaning a dominant orbital contribution. It is therefore a good candidate to investigate volume-dependent magnetism of Pt. In addition the Curie temperature is 450 K, well above the room temperature. In addition Pt_3Cr may be a good candidate for writing a magnetic network with low energy ions since the disorder which tends to form antiparallel Cr-Cr pair is known to kill the magnetism.
- The XMCD results show a very lively behaviour (**Figure 1**), which has to be more accurately determined.

  1st Pressure Cycle (dots): Initial XMCD maximum at 8 kbar, decrease up to 20kbar then increase up to 40kbars; when decreasing the pressure down to zero the signal goes through a maximum.

  2nd Pressure increase (triangles): was not studied in detail jump to 80 Kbar going to a decrease of XMCD.



More data are needed either at low pressure to clarify the magnitude of the initial increase or to check the non-reversibility when very high pressure has been created.
Part of this experiment was repeated twice to confirm the initial increase.

Conclusion

Thanks to the development of the local feedback which has been evaluated with a real X-ray produced signal at the end of the ID24 beamline, very significant improvements have been implemented - which overcome the major difficulties caused by speckle patterns.
Presently we didn't use the "turbo" scheme to totally suppress the speckle-induced noise at the expense of the rapidity of the data collection. The Pt L edge XMCD amplitude of a few percent makes the data collection easy with the parallel acquisition scheme.
The first Pt XMCD data under high pressure on ID24 allows a significant comparison: a 15 minute-long Pt XMCD spectra is currently achieved with a S/N ratio significantly better than the equivalent collected at LURE over night.