**E**UROPEAN **S**YNCHROTRON **R**ADIATION **F**ACILITY

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# Experiment Report Form

**The double page inside this form is to be filled in by all users or groups of users who have had access to beam time for measurements at the ESRF**.

Once completed, the report should be submitted electronically to the User Office using the **Electronic Report Submission Application:**

*http://193.49.43.2:8080/smis/servlet/UserUtils?start*

***Reports supporting requests for additional beam time***

Reports can now be submitted independently of new proposals – it is necessary simply to indicate the number of the report(s) supporting a new proposal on the proposal form.

The Review Committees reserve the right to reject new proposals from groups who have not reported on the use of beam time allocated previously.

***Reports on experiments relating to long term projects***

Proposers awarded beam time for a long term project are required to submit an interim report at the end of each year, irrespective of the number of shifts of beam time they have used.

***Published papers***

All users must give proper credit to ESRF staff members and proper mention to ESRF facilities which were essential for the results described in any ensuing publication. Further, they are obliged to send to the Joint ESRF/ ILL library the complete reference and the abstract of all papers appearing in print, and resulting from the use of the ESRF.

Should you wish to make more general comments on the experiment, please note them on the User Evaluation Form, and send both the Report and the Evaluation Form to the User Office.

## Deadlines for submission of Experimental Reports

- 1st March for experiments carried out up until June of the previous year;
- 1st September for experiments carried out up until January of the same year.

## Instructions for preparing your Report

- fill in a separate form for each project or series of measurements.
- type your report, in English.
- include the reference number of the proposal to which the report refers.
- make sure that the text, tables and figures fit into the space available.
- if your work is published or is in press, you may prefer to paste in the abstract, and add full reference details. If the abstract is in a language other than English, please include an English translation.

| ESRF | **Experiment title:** **XAS study of ferromagnetic nanoparticles** | **Experiment number**: **HE 2442** |
|---|---|---|
| **Beamline**: BM25A | **Date of experiment**: from: 14 March 2007 to: 21 March 2007 | **Date of report**: 30-9-07 |
| **Shifts:** 18 | **Local contact(s)**: **Dra. Ana CORDON RODRIGUEZ** | *Received at ESRF:* |


**Names and affiliations of applicants** (* indicates experimentalists):

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**Report:**

Granular magnetic systems formed by magnetic particles embedded in a non-magnetic insulator matrix, as well as metallic / insulator multilayers are now the subject of an increased interest for their applications in several fields of nanotechnology. These nanosystems present striking features associated with phenomena at the nanoscale, such as enhanced coercivity, magnetoresistance by means of tunnel junction effects, etc…

Besides, heterogeneous two-phase magnetic structures, consisting on a transition metal (TM) and its correspondent oxide (TMO) have been largely investigated as magnetic granular systems formed by ferromagnetic particles in an antiferromagnetic matrix, core-shell systems and thin films. TM / TMO systems present a very fascinating effect attributed to spin interactions between the metal and the oxide, resulting in an overcome of the superparamagnetic effect, enhancement of coercivity and, if the oxide component has sufficiently large anisotropy, exchange bias.

The experiment can be divided in two parts: firstly, we performed an accurate characterization of Fe / $Si_3N_4$ multilayered systems, focusing our attention in the differences at the short range order between as-prepared and thermally treated multilayers; finally, we tried to elucidate the effects of the preparation temperature on the structural features of partially oxidized granular cobalt thin films deposited at different substrate temperatures.

This experiment, carried out at the BM25A beamline at the fluorescence yield mode, provided very interesting results in both ferromagnetic granular systems, that will soon be submitted each of them to international journals.

XANES spectra at the Fe K-edge in the Fe / $Si_3N_4$ multilayers reveal that an adequate annealing can remove the nitrided phase formed in the interface regions. As it is observed in the figure, the XANES spectrum of the annealed sample results very similar to that of a Fe foil reference spectrum, whereas the as-prepared sample presents a more complex XANES spectrum that differs substantially from the reference, which we associate to a pure nitrided phase. This change in the local coordination around Fe due to post-growth treatment will affect directly to the magnetic and magnetothermal properties of such multilayered systems.

A preliminar analysis of the EXAFS spectra at the Co K-edge range energies from the partially oxidized cobalt thin films shows an evolution in the structural features of these samples as the preparation temperature decreases. As it can be observed in the Fourier transform, there is a progressive decrease in the amplitude of the peak corresponding to the first coordination sphere when lowering the substrate temperature. This decrease is explained by a reduction in the number of neighbours, which can be an evidence of a diminution in the average grain dimensions of the cobalt thin films.