EUROPEAN SYNCHROTRON RADIATION FACILITY

INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON

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 via the User Portal:

https://wwws.esrf.fr/misapps/SMISWebClient/protected/welcome.do

Reports supporting requests for additional beam time

Reports can 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:** Structural dynamics in Cobalt Nanoparticles	**Experiment number**: CH-4003
Beamline: ID09B	**Date of experiment**: from: 5 dec. 2013 to: 11 december 2013	**Date of report**: March 2014
Shifts: 15	**Local contact(s)**: Federico ZONTONE, Michael WULFF	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

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Report:

Purpose, Expected Results, Preparation:
The purpose of the beamtime was to study the solid-solid phase transition of Cobalt Nanoparticles (CoNP's) in liquid solution. By laser-exciting a solution of CoNP's the epsilon particles should transform to a hcp or fcc structure depending on the applied laser intensity (i.e. the particle temperature acchived from laser pumping). After pumping, the hcp/fcc transformed particles was expected to completely relax to hcp structure which is stable at room temperature.

The experiment was a continuation of HS-3270 (may 2007), where technical difficulties reduced the amount of effective beamtime to less than 24 hrs. at reduced intensity.

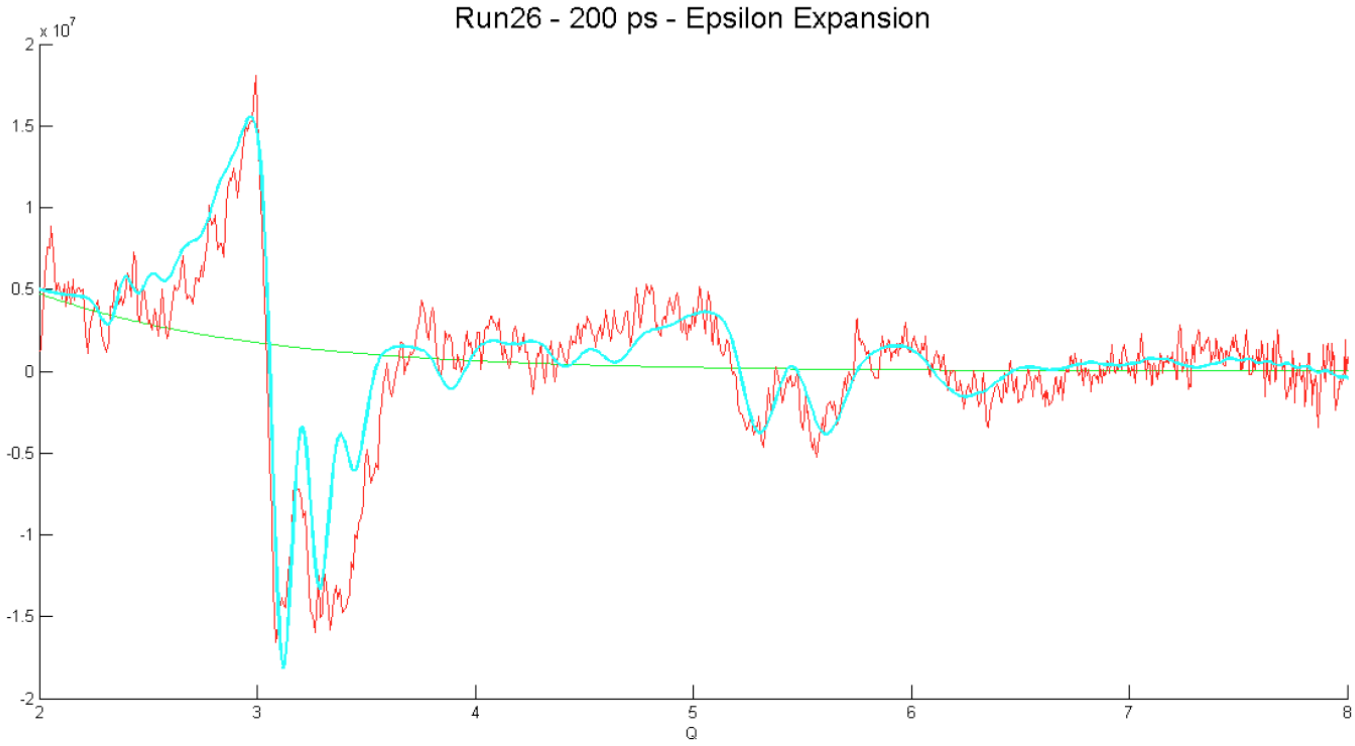
Preparation:
Epsilon phase Cobalt Nano Particles where prepared at the Technical Univeristy of Denmark and characterized by Transmission Electron Microscopy (TEM) prior to the beamtime (a standard batch would contain 7 nm epsilon-CoNP's coated by oleic acid). A simulation software tool was created for simulating difference scattering signals from nano particles (NP's) depending on structure, lattice constant and size.

Method:
The laser pump – X-ray probe setup at beamline ID09B was used. The sample solution is cycled through a liquid jet with a sapphire nozzle producing a 300 micron liquid sheet. An array of rotating chopper wheels isolates a single X-ray pulse from the synchrotron and the sample is excited by a femtosecond laser pulse with selected arrival time prior to arrival of the X-ray pulse.

Setup:
The experiment was performed using a pink 15 keV X-ray beam reflected off the Ru-multilayer to get rid of un-desired X-ray arising from e.g. higher harmonics. The sample was excited using a 400 nm laser beam and the diffraction images collected on a FReLoN detector.

Results:
We managed to identify a complete epsilon->hcp phase transition after 100 ps, and monitored that the hcp phase remained stable on a timescale of at least several hundred nanoseconds. Detailed timeslicing of the sub-100 ps difference signals reveals that the epsilon-hcp transition does not occur in a single, well defined step.

The difference scattering curve at 200 ps, fitted to the structural changes from thermal expansion of the epsilon particles (at low laser intensity. Better fits showing the phase transition has been acquired.



Conclusions and Outlook:
Thanks to the software prepared prior to the beamtime, we managed to perform a rough on-site analysis during the experiment, which ensured optimum use of the allocated beamtime. We are currrently preparing a manuscript for publication of the results.