EUROPEAN SYNCHROTRON RADIATION FACILITY

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ESRF

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:** **Structural investigation of Co-B ferromagnetic nanoparticles in ZnO single crystals**	**Experiment number**: 20-02-678
Beamline:	**Date of experiment**: from: 17.06.2009 to: 20.06.2009	**Date of report**: 12.01.2010
Shifts: **9**	**Local contact(s)**: Dr. N. Jeutter	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

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Report:

Series of ZnO single crystals implanted with Co and B have been characterized by synchrotron radiation x-ray diffraction technique at ROBL. These experiments partially represent one of the research topics of Nanofunctional Films Group at FZD, namely, development of magnetically active semiconductimg materials.

The ZnO substrates were implanted with B ions and with Co ions with energies 30keV and 80 keV respectively. The fluences of implanted Co were chosen as 8×10^{16} and 16×10^{16} (cm^{-2}). The dose of B ions has been varied from 5×10^{15} up to 32×10^{16} cm^{-2} for different samples. According to the aim of the application it was necessary to identify the origin of magnetism in these samples. Such a source supposed to be represented by magnetic Co-based secondary phases.

Using coplanar x-ray diffraction technique in a wide range of angles, we performed set of measurements which did not reveal presence of additional crystalline phases, except of ZnO host material. We would note that in the case of nanoparticles self-organization, the concentration of Co-inclusions should be sufficient for their detection, similarly to MgO:Fe systems, where the doses of implanted ions where equal to those studied in the current proposal. Absence of diffraction pattern from secondary (Co-B)-based phases, leads us to a conclusion that those inclusions are in the amorphous state. High-resolution diffraction of the ZnO substrates proves an enhanced diffuse scattering near the reciprocal lattice points of ZnO. Using the relations of Huang and Stockes – Willson scatterings the average size of

nanoparticles was estimated. We have found that dimensions of (Co-B) – inclusions are in the range from 10 to 40 nm. The size of nanoparticles increases with an increasing of B fluence being in good agreement with SQUID measurements. At the present state, the results of the experiments performed at ROBL, as well as at FZD, are in preparation for publishing.
In addition to the measurements of Co-B implanted ZnO, the structural investigations of Fe implanted GaN have been performed. The results of these structural measurements show the correlation between structural and magnetic properties of ion implanted GaN:Fe. It was concluded that spinodal decomposition is the preliminary stage before the formation of precipitates. The results of this experiment jointed with the data of magnetic and spectroscopic investigations are submitted to Physical Review B.