Experimental Report

04/03/2008

Proposal: **1-01-43** **Council:** 4/2007

Title: Magnetic Quantitative Texture Analysis (MQTA) using neutron diffraction data

This proposal is a new proposal

Researh Area: Physics

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Samples: Nd-Fe-V, Fe-Si ...

Instrument	Req. Days	All. Days	From	To
D19	4	2	09/11/2007	12/11/2007

Abstract:

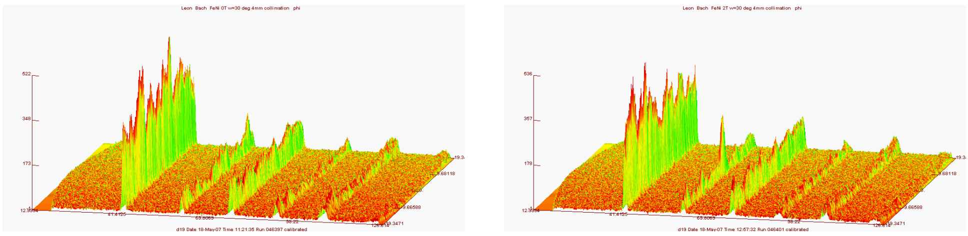
Neutron diffraction is able to probe complex magnetic structures and crystallite texture from nuclear diffraction, then can potentially measure magnetic texture from magnetic diffraction. It is proposed here to further develop an approach already accepted in 2005 (5-26-176): acquiring magnetic diffraction peaks versus sample orientation, to analyse the magnetic orientation distribution functions. The previous proposal stated the beginnings of the QTA development on D19. We were able to make some measurements on the new detector D19 to confirm the QTA development and test new samples for the magnetic texture research. First, the development of QTA seems to be confirmed, but the first measurements made on ferromagnetic samples are not very exploitable. It would seem that the magnetic signal is very weak contrary to the nuclear signal. To improve our experiments, it would be necessary to increase the efficiency, this passing by longer acquisition times. At the last proposal round we obtained some measuring days (proposal 1-03-4, still not operated) in October 2006, but in sight of these results, it would seem that we need more time, and add on new samples.

Magnetic Quantitative Texture Analysis (MQTA) using neutron diffraction data.

The first measurement carried out without magnetic polarisation of the sample in different orientations, provides the global orientation distribution functions. In the second step, by applying an external magnetic field of 0.3 to 0.5T using permanent magnet mounted on a special sample holder, we measure neutron diffraction patterns in the same orientations of the sample. A set of 1368 diagrams corresponding to all orientations are measured without and with magnetic field in order to extract the magnetic orientation distribution function (MODF).

Thanks to the new possibilities offered by D19 we were able to extract the first induced magnetic orientation distribution function.

Figure 1 shows the neutron diffraction patterns obtained from a soft iron commercial for given orientation, without a field (a) and with a field of 0.5T (b). The field induced magnetic signal is weak where it is well shown in the difference (figure 2).



(a) *(b)*

Figure1: Debye-Scherrer diagrams measured for χ=90 ° and φ = 175 ° without (a) and with a field of 0.5T (b).

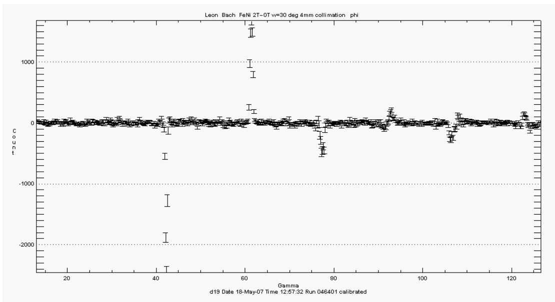
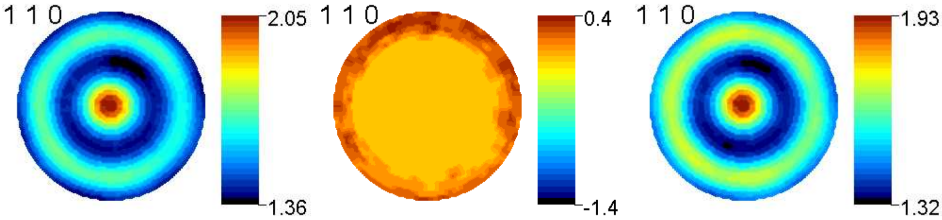


Figure 2: Difference between two diagrams with and without field 0.5T for χ=90 ° and φ = 175 °.

This difference is a characteristic of the induced orientation of the magnetic moments due to the applied magnetic field. The analysis of this magnetic contribution at different positions of the sample would lead to magnetic orientation distribution function (MODF). Due the weak induced magnetic signal, we needed to measure for longer time comparing to standard texture measurements.

Figure 3 shows the first promising magnetic orientation distribution functions (MODF) deduced for iron alloy. The quantitative interpretation on this pole figures is in progress.



(a) *(b)* *(c)*

Figure 3: (a) Pole figure on iron alloy without a field,
(b) difference with and without field and (c) magnetic pole figure.

However, this potential "magnetic" texture still should be confirmed with other ferromagnetic samples such as FeSi compound with relatively low coercive fields.

We would like to measure then two samples FeSi and NdFeV. These samples are relatively small in size (0.8 cm^3) due to the process, and we correlatively need quite long exposure times.

We would request 3 days on D19 to complete this magnetic texture approach.

References :

M. Morales, D. Chateigner, D. Fruchart: *Journal of Magnetism and Magnetic Materials* , **257(2)**, 2003, 258-269.
M. Morales, D. Chateigner, L. Lutterotti, J. Ricote: *Materials Science Forum*, **408-412**, 2002, 113-118.
H.-R. Wenk, F. Heidelbach, D. Chateigner, F. Zontone: *Journal of Synchrotron Radiation*, **4**, 1997, 95-101.