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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 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: Microdiffraction tomography of localized martensitic transformation in thin NiTi wires under various loadings**	**Experiment number**: MA-2114
Beamline: ID15A	**Date of experiment**: from:16/07/2014 to:20/07 2014	**Date of report**: 01/02/2019
Shifts: 12	**Local contact(s)**: Agnieszka Poulain	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

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Report:

The aim of the experiment was to map the spatial distribution of first order martensitic transformation induced by various loading conditions in superelastic NiTi wires of diameter 0.1-0.2 mm. We focused our experiments on tension, combined tension/torsion and bending loading conditions. The bending conditions were reached by using a specific snake-like wire shape while the other conditions were applied to straight wires. To probe the spatial distributions of parent austenite (cubic, B2) and stress induced either R-phase (trigonal) or martensite (monoclinic, B19') structure, the NiTi wire gauge volume was scanned with a microbeam (~20um x 5 um) in two directions. The volume distributions were reconstructed while assuming the axial symmetry (tension, tension/torsion) or planar symmetry (bending). The post-processing of collected 2D diffractograms was performed using batch processing based on PyFAI library used for calibration and 2D diffractogram integration and Maud and GSAS softwares used for Quantitative phase analysis applied on fully integrated diffraction spectra.

NiTi wire under bending

Fig. 1 presents the experimental setup aimed at analysing distributions of R-phase and martensite induced by bending of a snake-like shape set NiTi wire. Here a gauge volume of 0.5x0.12 mm was scanned by microbeam as shown in the inset figure in Fig. 1. 2D diffractograms collected from each scanned point, where fully integrated and subsequently analysed by Rietveld refinment in order to obtain the volume fraction of three considered phases – austenite, R-phase, martensite. Fig. 2 show colormap resulting from Rietveld refinement that actually proves that tension-compression asymmetry effectively shifts the

neutral axis of the bending deformation from the wire axis. The results also allowed to calibrate material model of the constitutive behaviour of superelastic NiTi as published in [1]

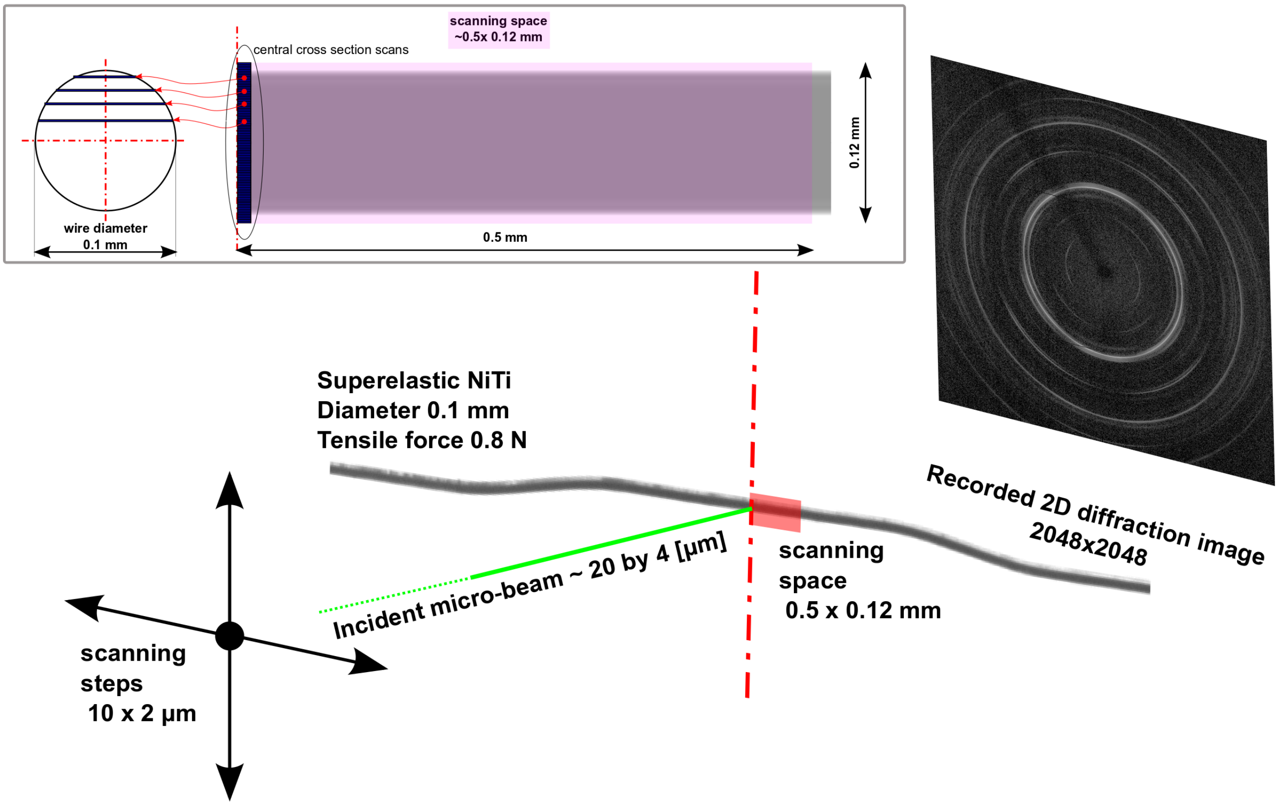
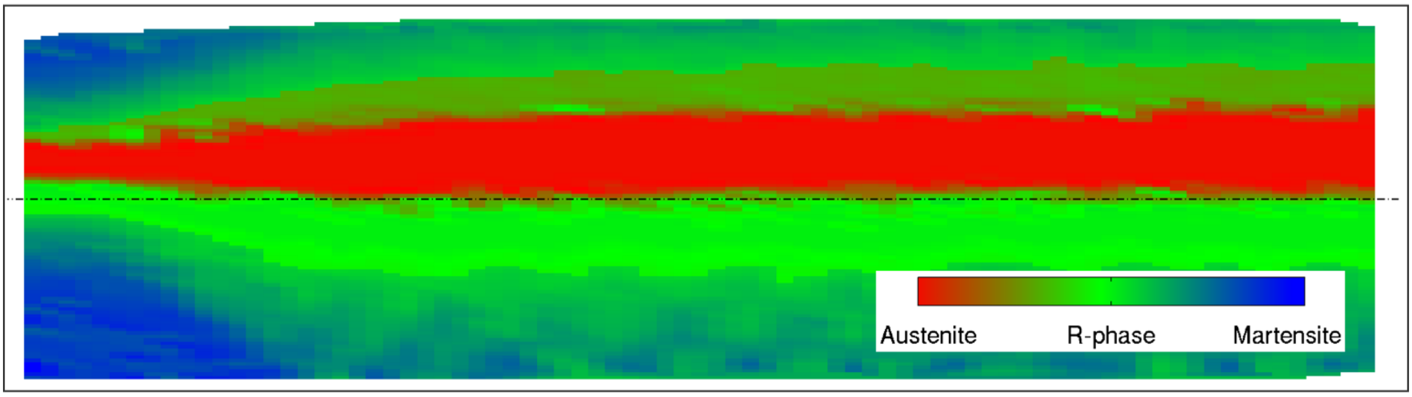


Fig. 1: Scheme showing the experimental setup probing the distributions austenite and stress-induced R-phase and martensite in bent superelastic NiTi wire of diameter 0.1 mm.



NiTi wire under combined tension/compassion

The post-processing approach adopted in the case of bent NiTi wire was also applied on 2D diffractograms collected in-situ on superelastic NiTi wire subjected to combined tension/torsion with different loadings rations. The analysis is actually still in processes.

In fact, the development of reliable programming codes for post-processing of thousands of collected 2D diffractograms have been time consuming and, therefore, we postponed the report elaboration until first results and publications were available.

Publish papers

[1] M. Frost et al., Experimental and computational study on phase transformations in superelastic NiTi snake-like spring, Smart Mater. Struct. 27 (2018) 095005 (10pp),