ESRF	**Experiment title: Ŭ-Ti internal strain evolution under thermomechanical loading**	**Experiment number**: ME1356
Beamline: ID15B	**Date of experiment**: from: 25/06/2014 to: 27/06/2014	**Date of report**: 11/08/2014
Shifts: 6	**Local contact(s)**: Agnieszka POULAIN	*Received at ESRF:*

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Report:

The aim of these experiments was to study of the elastoviscoplastic behavior of polycrystalline Ŭ-Ti by x-ray diffraction in line with the development of a more complete scale transition model. Experiments were performed uppon 2 series of 6 commercial purity (99.9 at.%) Ŭ-Ti dogbone shaped specimens, machined from cold rolled sheets along and crosswise the rolling direction, respectively.

We have performed *in situ* tensile tests thanks to a dedicated Instron 8800 electrothermomechanical tester mounted on the diffractometer at ID15B beam line, with a 2D detector at an X-ray energy of 87 keV according to penetration depth and crystallographic planes targeted. We have scheduled the 6 allocated shifts as follow:

- 2 for energy and focalisation adjustment, temperature calibrarion and preliminary tests;
- 2 for measurements on the samples machined along the rolling diraction;
- 2 for measurements on the samples machined transversal to the rolling diraction.

6 monotonic loads up to 20% at a constant strain rate of 4.10^{-4} s^{-1} have been performed at different temperatures (ranging form room temperature up to 500°C) on each sample series. The diffraction rings have been recorded thanks to a Pixium 4700 flatpanel detector (2D) positionned in agreement with the targeted {hkl} diffracting planes and signal optimizating. It should be noted that those measurements would not have been possible with a conventional x-ray source regarding Ti creep behavior requiring a short acquisition time (2 s aquistion time) and required pentration depth.

Measurements have allowed following internal strain development as a function of applied load (first loading state taken as a reference) at different temperature uppon various crystallographic orientations, enabling us to describ the different deformation modes and their activity. Preliminary results are presented in Fig. 1 and concern measurements performed along a direction close to the tensile axe at room temperature and 200°C on {1,0,0}, {0,0,2} and {1,0,1} diffraction peaks.

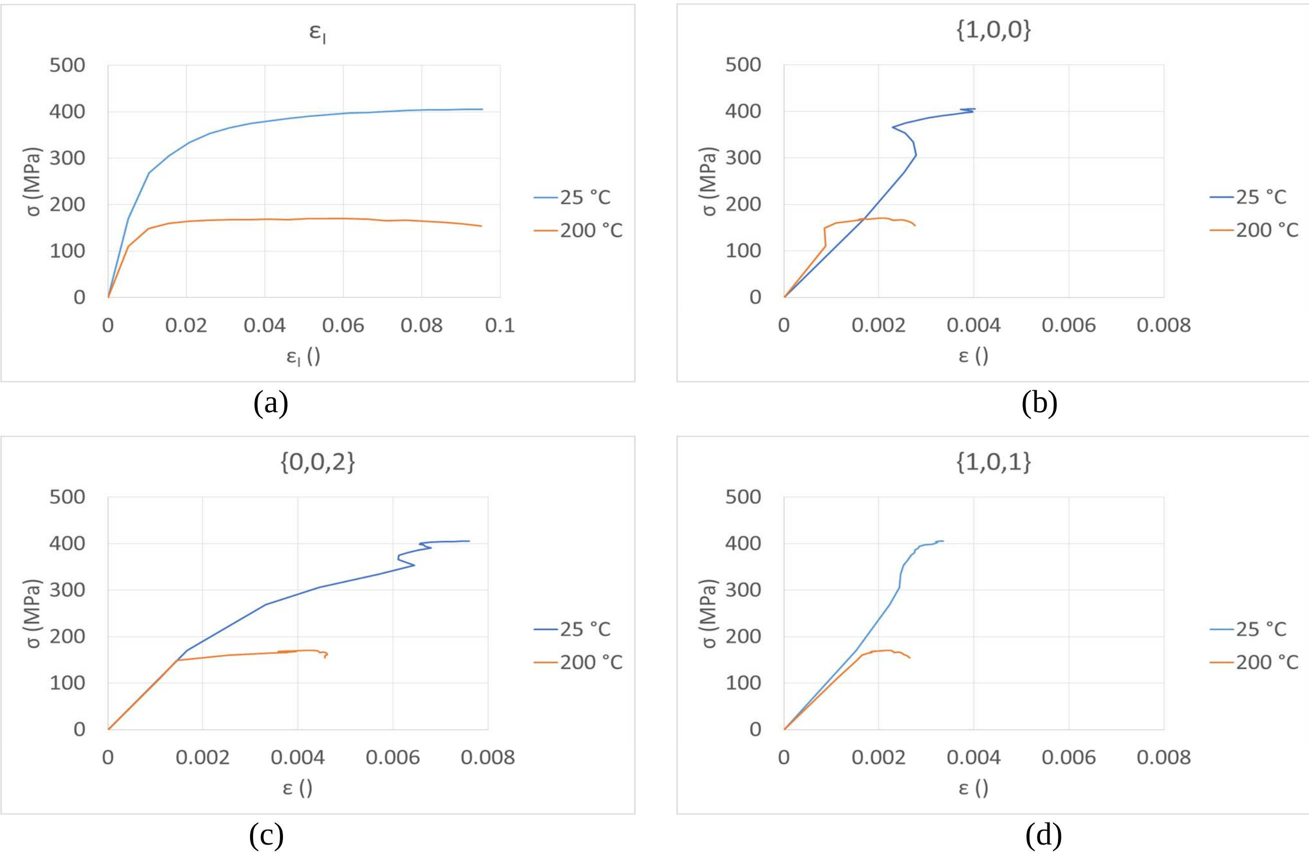

Fig. 1: (a) Macroscopic strain as a function of estimated applied stress along loading axis. Strain measurements deduced from (b) prismatic {1,0,0} (c) basal {0,0,2} (d) pyramidal {1,0,1} diffracting planes along directions close to the tensile axe according to this same estimated applied stress.

Temperature and orientation dependances of deformation of Ŭ-Ti, observed on Fig. 1, need to be confirmed and quantified by means of a thorough analysis of all experimental data (other diffracting plane families). Altough, first data analysis show promising results in terms of active deformation systems as a fonction of temperature. Those informations will then have to be combined with elasto-visco-plastic self-consistent model (undeway) in order to characterize with accuracy the evolution of plastic anisotropy with temperature at the grain level.

It should be emphasised that strain measurements would have been extremely difficult to complete without a synchrotron x-ray source and further experiments would be needed to study other aspects that can affect those deformation mechanisms such as phase inter-dependance or grain morphology.

It has been found out that the obtained data are of good quality and that the beamline was well matching the requirements of this study. The interpretation of data is not completed at present but first analysis are showing encouraging observations. Final results will be published as soon as possible in international journals.