ESRF	**Experiment title:** Micromechanics of metastable TRIP steels at variable temperatures	**Experiment number**: MA-1340
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Report:

Low-alloyed transformation-induced plasticity (TRIP) steels exhibit a microstructure composed of ferrite, bainite and retained austenite, where the austenite is present in a metastable state. The remarkable combination of strength and ductility comes from the stress-induced transformation of the metastable austenite into martensite. The aim of this experiment was to monitor in-situ the stability of individual austenite grains embedded within the complex multiphase TRIP steel under applied stress. In situ high-energy X-ray diffraction (XRD) experiments were performed at the ID11 beamline. The monochromatic X-ray beam with an energy of 69.52 keV made it possible to obtain diffraction patterns from the bulk material in transmission geometry. A square beam size defined by slits with a dimension of 50×50 μm^2 was chosen in order to illuminate a small number of grains within the cylindrical bar-shaped tensile sample. For this experiment, a two-dimensional CCD detector (FRELON) and a prototype HIZPAD 1 mm CdTe pixel detector with 256×256 pixels covering an area of 14×14 mm were placed behind the sample at 252 and 3239 mm, respectively. The difference in resolution between both detectors is clearly illustrated in Fig. 1. As illustrated in Fig. 2 the experimental setup allowed us to characterise the rich sub-grain structure of 4 individual austenite grains and monitor their evolution during tensile loading [1]. It was found that the austenite grains already contain a pronounced initial substructure before any mechanical load has been applied. The corresponding dislocations are expected to be the result of local transformation strains during the TRIP heat treatment. Austenite grains have been tracked during tensile deformation at stress level lower than the macroscopic yield stress. Most austenite grains show a complete martensitic transformation in a single strain step. Additional in-situ microbeam XRD experiments were performed during tensile deformation at low temperatures with a single FRELON detector.

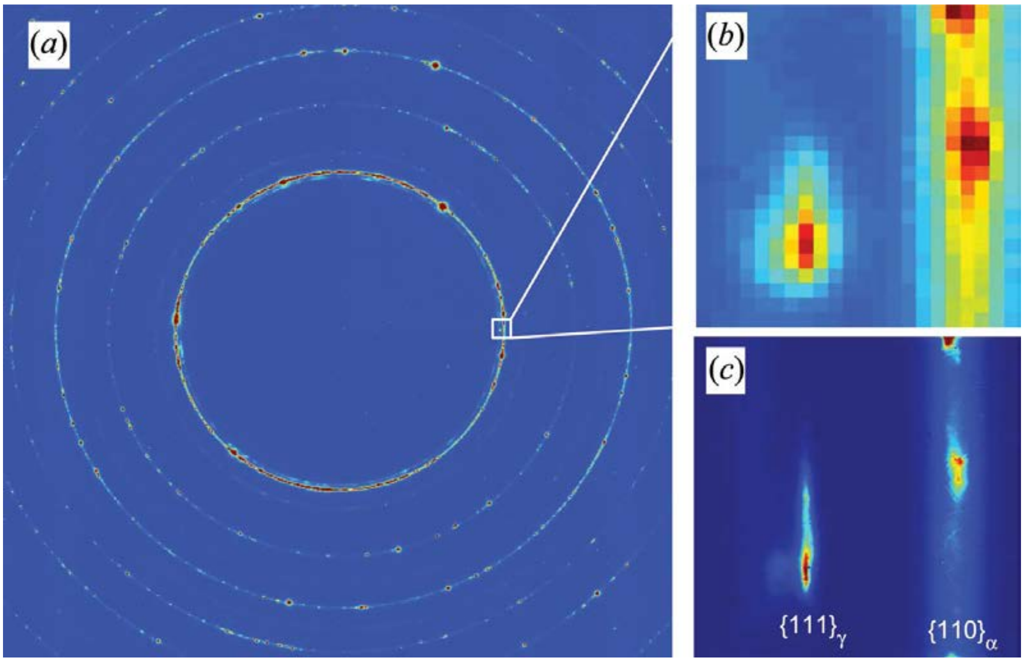

Fig. 1: Two-dimensional X-ray diffraction pattern of the TRIP sample. The pattern monitored on the medium-field detector (a) shows both ferrite and austenite reflections on separate diffraction rings. (b) A zoom of the medium-field data that shows a single austenite diffraction peak from the $\{111\}_\gamma$ *ring and part of the* $\{110\}_\alpha$ *ring of ferrite. (c) The corresponding image monitored on the far-field detector provides a higher resolution.*

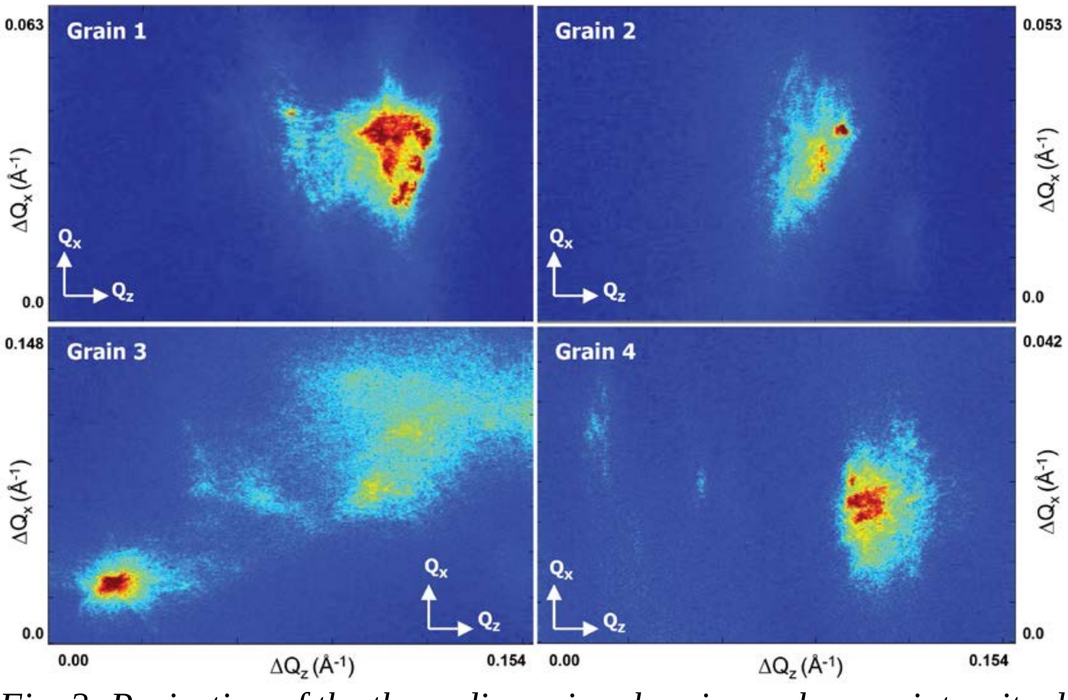

Fig. 2: Projection of the three-dimensional reciprocal space intensity distribution onto the azimuthal plane Q_xQ_z *at no deformation.*

Reference:

[1] R. Blondé, E. Jimenez-Melero, L. Zhao, J. P. Wright, E. Brück, S. van der Zwaag, N.H. van Dijk, Journal of Applied Crystallography 47 (2014) 965-973.