ESRF	**Experiment title:** In-situ high energy diffraction study of the transformation induced plasticity in dual phase stainless steels	**Experiment number**: MA2307
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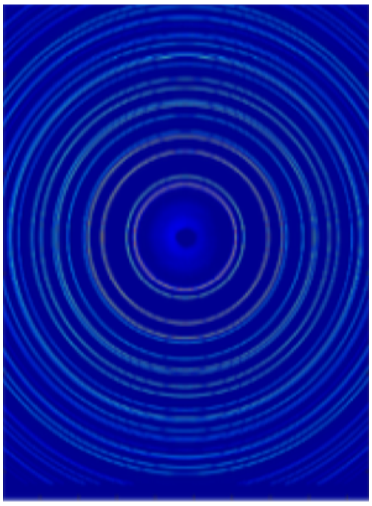
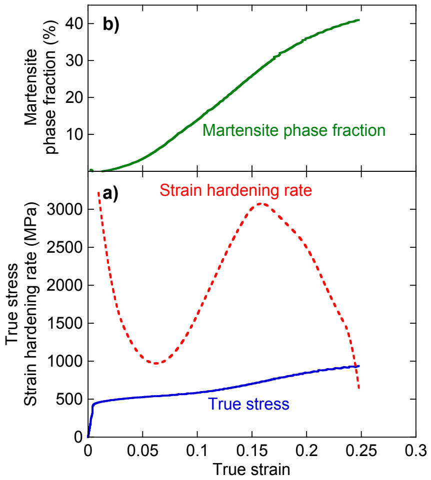
Report:

This experiment aimed at characterizing the phase transformations during straining of stainless steels exhibiting the transformation induced plasticity (TRIP) effect. More specifically, it was sought to evidence the effect of chemical composition on the stability of austenite with respect to the TRIP effect, and the effect of a dual phase microstructure ferrite / austenite. This characterization was carried out using in-situ high energy X-ray diffraction (HEXRD) at 90 keV beam energy. The Debye Scherrer diffraction rings were continuously recorded during the sample straining until fracture. They were then analyzed by a Rietvelt analysis. In addition to the phase fractions, a parallel study involving also dual phase stainless steels, without TRIP effect, was carried out to evaluate the stress partitioning between the two crystallographic phases (austenite and ferrite) all along a tensile test, by following the displacement of the various diffraction peaks. All the experiment was a complete success. We carried out about 50 tensile tests with a continous measurement of diffraction rings. This data was used as an important part of two PhD studies corresponding to the two subjects above. Thes two PhDs have been defended (A. Lechartier & H. Naser). From this work it is expected that 3 to 4 papers will be published. To this date, one is submitted.
Below we give some examples of acquired data

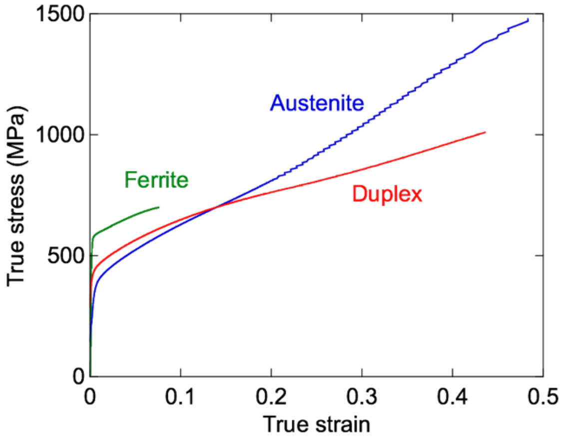
1. Relation between TRIP effect and strain hardening rate

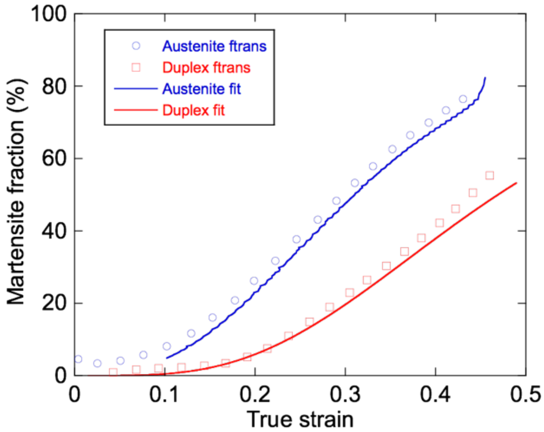
The TRIP effect consists in the formation of martensite during a tensile test. Here we evidence on a duakl phase stainless steel the correlation between the martensite phase fratcion (determined by in-situ HEXRD and the mechanical response (strain hardening rate induced by the phase transformation)





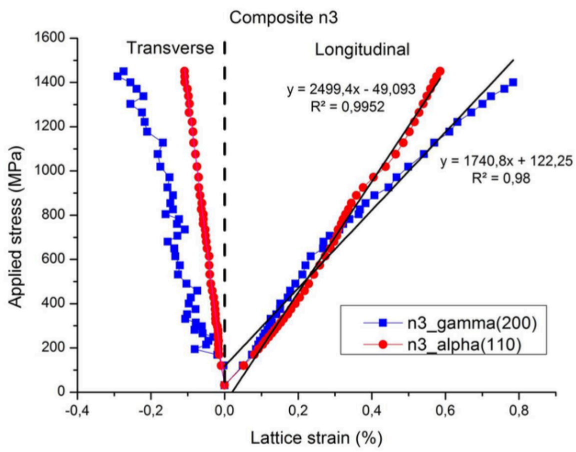
2. Effect of dual phase microstructure

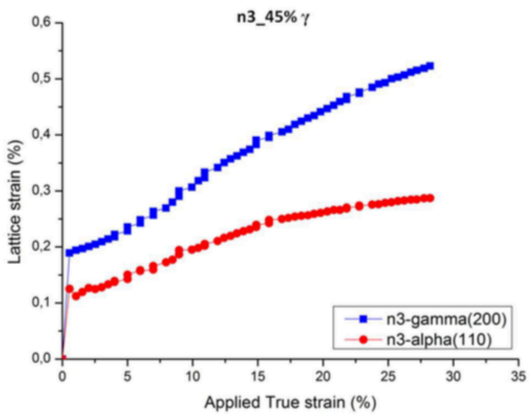




In order to understand the effect of the dual phase microstructure (50% anstenite and 50% ferrite in the duplex steel), a fully sustenitic and a full ferritic steel of identical compositon as their counterparts in the duplex steel have been elaborated. In-situ HEXRD tests evidence that the TRIP effect is strongly different in the fully austenitic steel and in the duplex microstructure, revealing an effect of the presence of ferrite on the martensite formation kinetics.

3. Stress partitionning in dual phase steel during straining





Stress partitioning has been evaluated by studying the displacement of diffraction peaks along and normal to the straining direction, in the two phases of the steel. These result evidence that the austenite, which presents a stronger strain hardening capability, carrieds a higher fraction of the imposed load.