ESRF	**Experiment title:** **Hot deformation of steel and titanium based materials**	**Experiment number**: Ma727
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Names and affiliations of applicants (* indicates experimentalists):

Cecillia Poletti*[1]

Hans Peter Degischer*[1]

Guillermo Requena*[1]

Fernando Warchomicka*[1]

David Canelo Yubero*[1]

Domonkos Tolnai*[1]

[1] Institute of Materials Science and Technology – Vienna University of Technology

Report:

In situ diffraction tests during temperature exposure and tensile deformation were carried out at the ID15B beamline for an unreinforced Ti662 alloy, a TiC particle reinforced Ti662 alloy and three low carbon steels. Synchrotron tomography to study the damage in the fractured samples was subsequently performed at the ID15A.

The experiments are still in the stages of processing and interpretation. We present here the current the analysis of the results obtained so far for one of the low carbon steels:

The specimens were taken from the surface of continuously cast low carbon steel slabs to quantify the phase fraction during continuous cooling and deformation in the range of austenite (γ) $\rightarrow$ ferrite (α) transformation. The main objective of the experiment was to study the induced phase transformation occurring during deformation.

The samples were tested using a thermomechanical simulator machine. Fig. 1a shows the temperature profile used for the specimens to determine the phase transformation temperature (Td) during cooling: heating from room temperature to 1150 °C at 10 °C s^{-1}, 60s holding and cooling to 500 °C at 1°C s^{-1}. Fig 1b shows the Temperature vs time profile used to determine the influence of the high temperature deformation on the phase transformation. The samples were deformed at $3x10^{-3}$ s^{-1} until fracture after a holding time of 30s or hold at 200s without deformation.

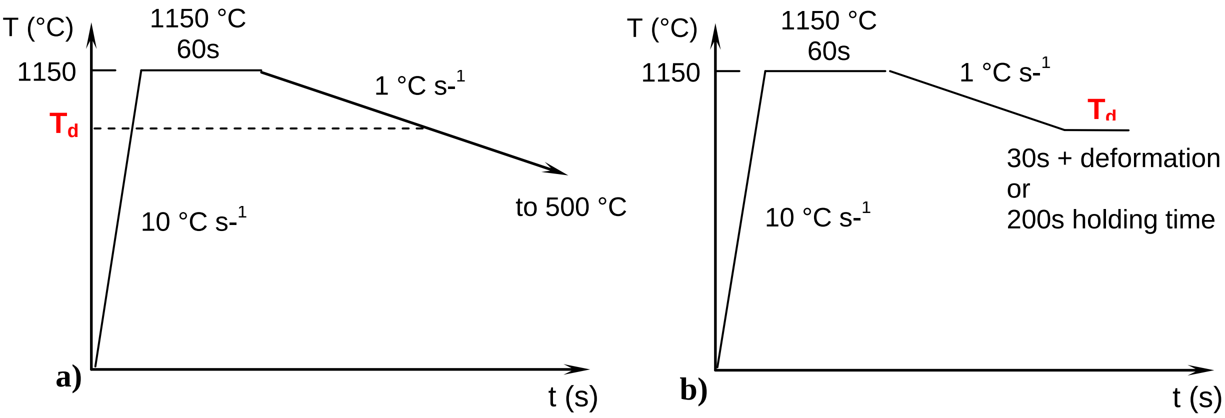

Figure 1: Temperature profiles used during the experiments for low carbon steel.

The obtained diffraction patterns were processed using the TOPAS software in cooperation with the Institute of Chemical Technology and Analytics of the TU-Vienna (Prof. Franz Kubel).
Figure 2 shows the quantitative evolution of the ferrite and austenite phases during cooling from 800°C to 600°C. The phase transformation temperature is determined to be between 750°C and 760°C, which correlates well with dilatometry results.

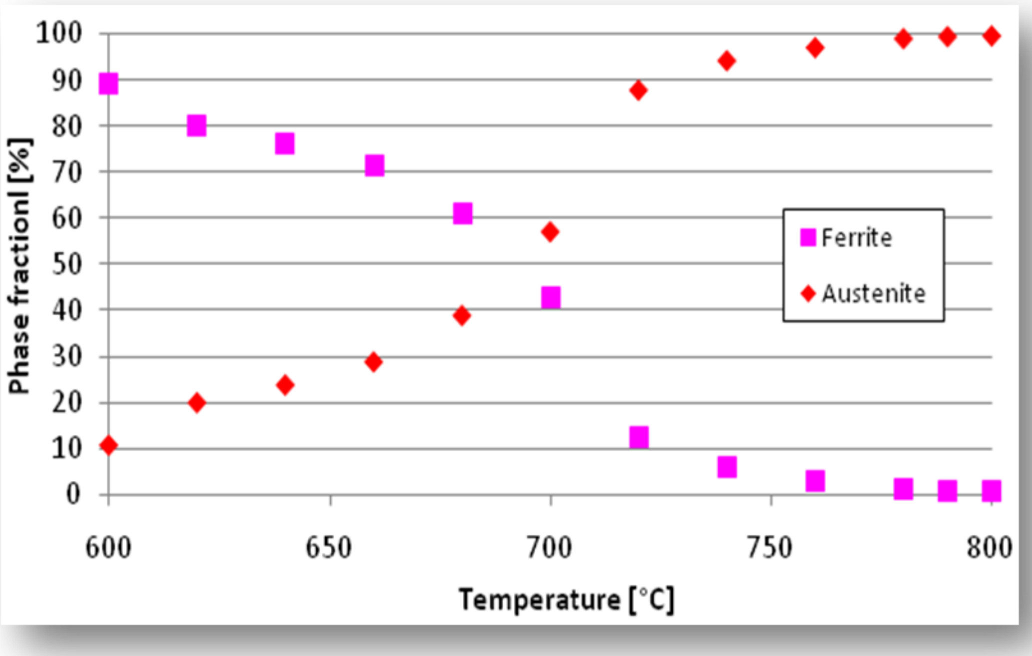

Figure 2: Evolution of ferrite and austenite content during cooling of a low carbon steel.

The dependency of the ferrite formation as a function of the deformation at 800 °C is displayed in Figure 3. It is observed that a deformation of at least 0.37 is needed to induce the ferrite formation at 800°C. This result still has to be compared with the isothermal measurements carried out at 800°C for a holding time longer than 0.37/0.003 $s^{-1} \simeq 120$s.

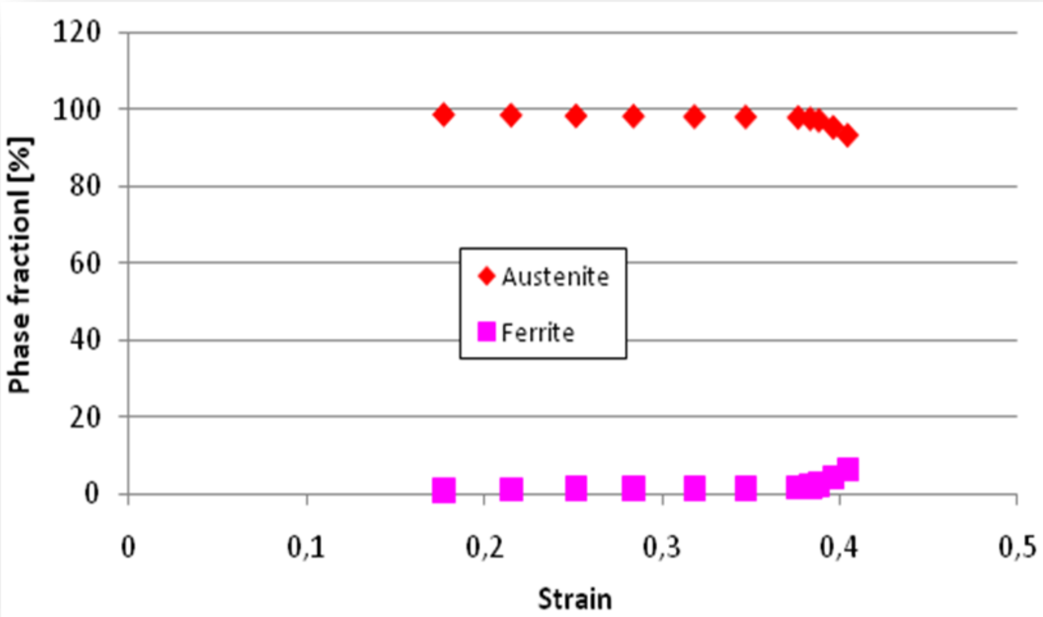

Figure 3: Deformation denpendance of the ferrite and austenite formation at 800°C of sample A15