VIENNA UNIVERSITY OF TECHNOLOGY
Institute of Materials Science and Technology

Contact : david.yubero@tuwien.ac.at

Load partitioning and microstructural evolution in Ti-alloys during hot tensile tests

D. Canelo Yubero[(1)], C. Poletti[(2)], F. Warchomicka[(2)], G. Requena[(1)]

[(1)] Institute of Materials Science and Technology, Vienna University of Technology, Austria
[(2)] Institute for Materials Science and Welding, Graz University of Technology, Austria

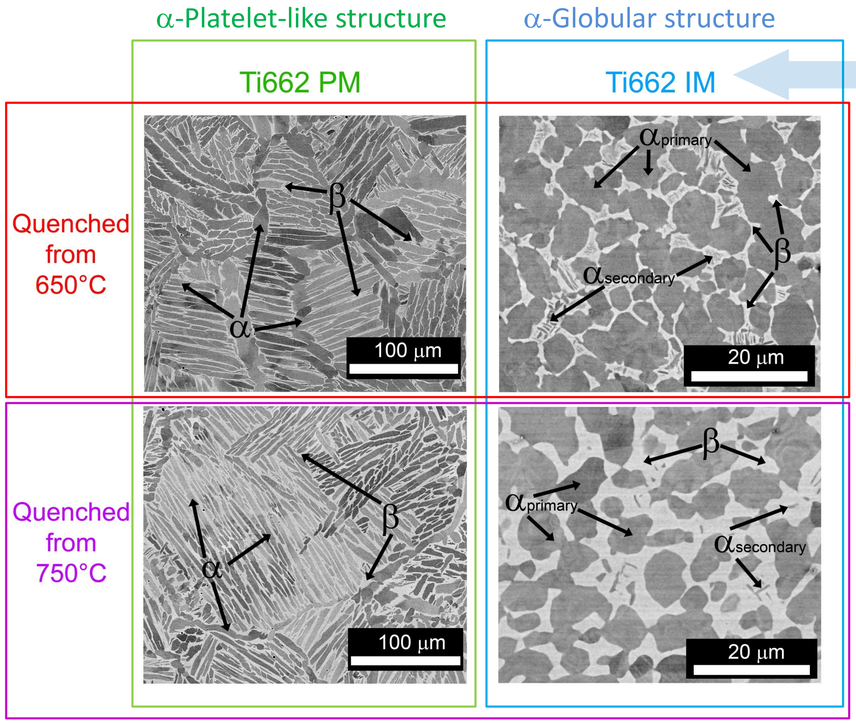
Goal

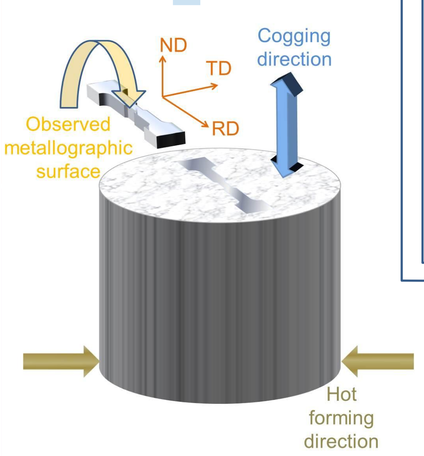
In situ synchrotron diffraction during high temperature deformation of Ti-alloys to determine:

a) Load partition between α- and β-phases
b) Microstructural evolution of α- and β-phases.

Materials

PM: Powder metallurgy — α-Platelet-like structure
IM: Ingot metallurgy — α-Globular structure

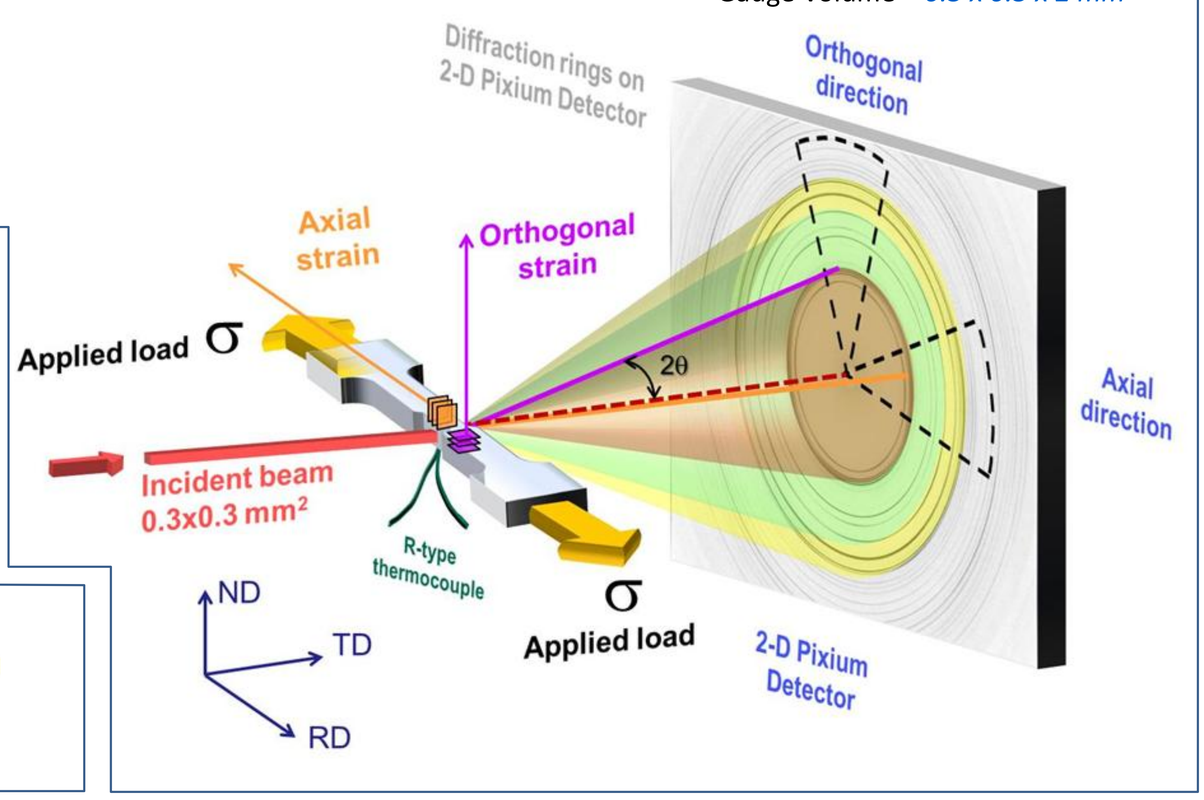




Experimental

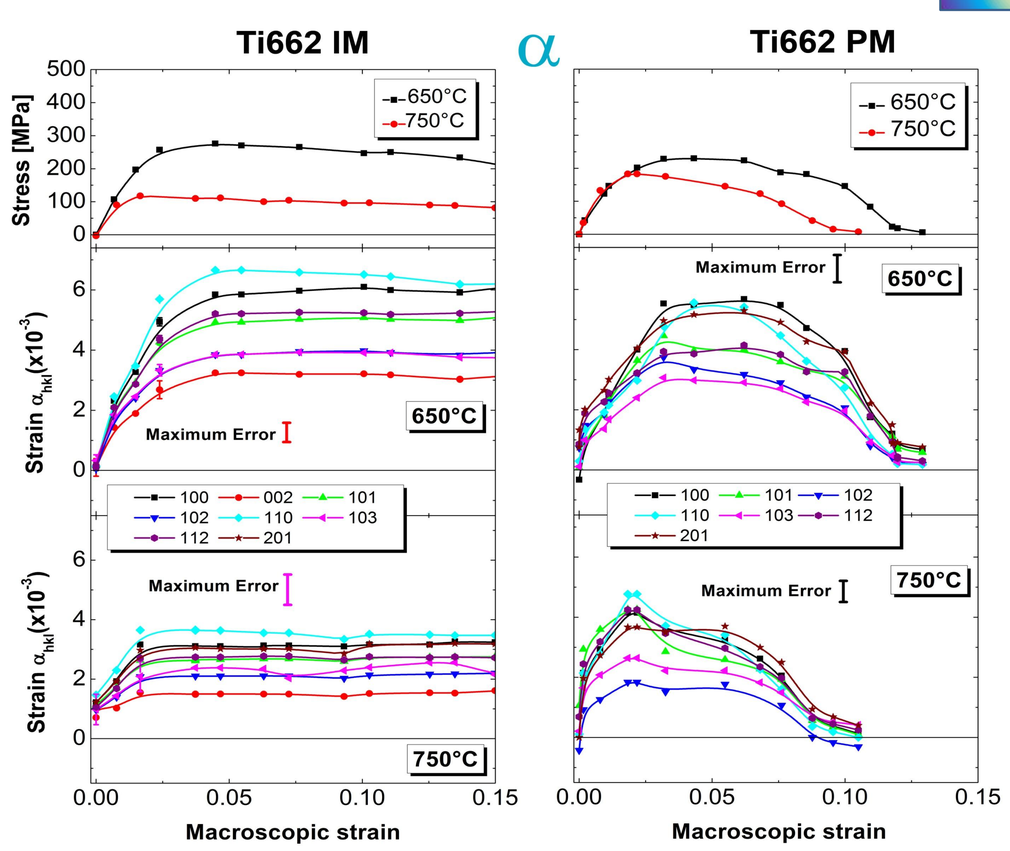
Tensile tests
- T = *650-750°C*
- Strain rate: *$0.01 s^{-1}$*
- *Argon* atmosphere
- *Current heating* → Similar to Gleeble system

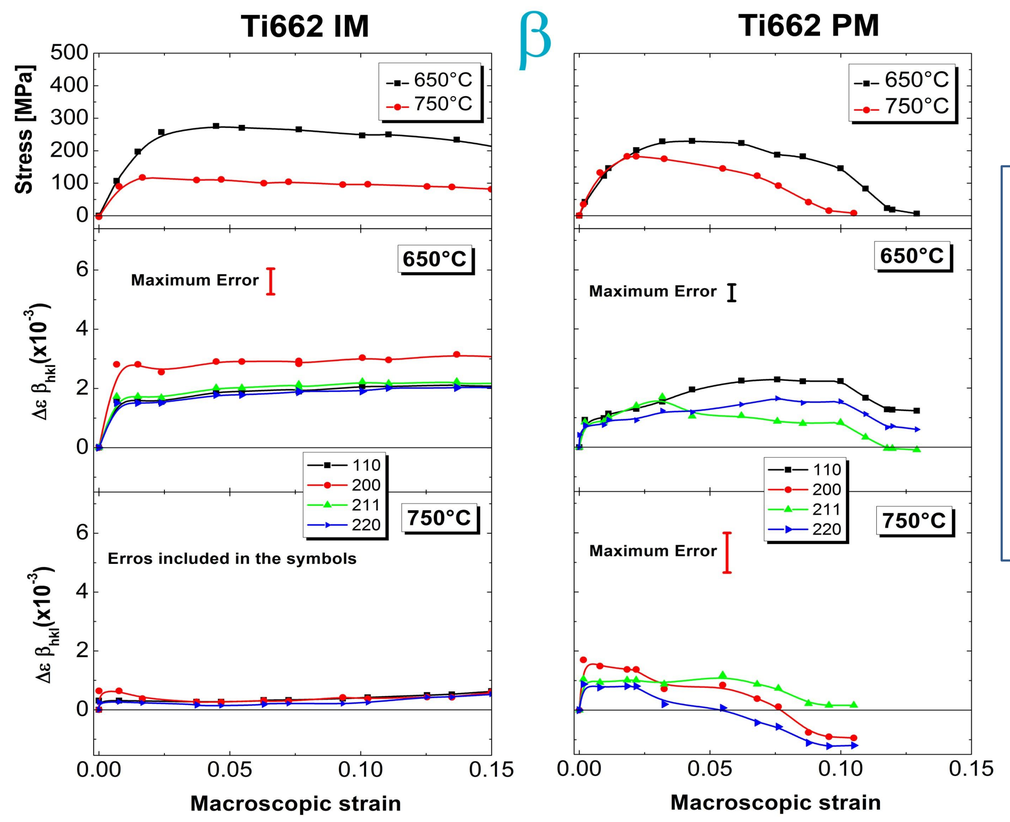
In situ diffraction
- Beamline: *ID15B ESRF*
- E = *87.5KeV*
- Acq. Time ~ *0.7 sec/frame*
- Gauge Volume = *0.3 x 0.3 x 2 mm^3*



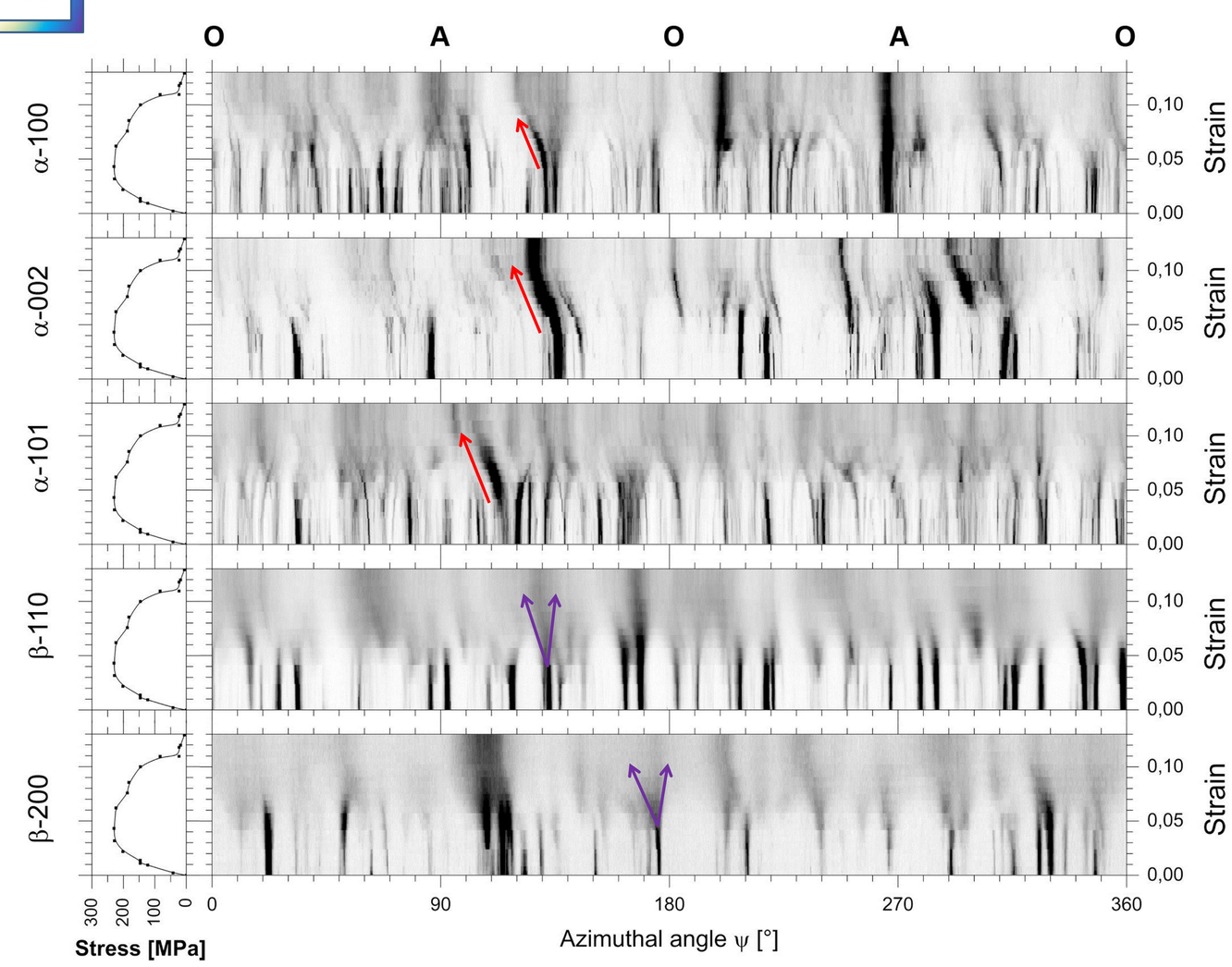
Results

Axial strain evolution at 650°C and 750°C





Microstructural evolution at 650°C — Rotation — Subgrain formation



Conclusions

- The IM alloys show less softening than the PM alloys
- The lattice strain evolution is similar to the macroscopic curves for the PM material
- α-110, α-100 and α-201 show the highest strains while α-002, α-102 and α-103 exhibit the lowest
- The β-phase plastifies in early stages of the tensile tests. This was mainly observed in the IM alloy since the PM has lower statistics owing to the large grain size
- The α-phase carries more load than the β-phase in both alloys and temperatures
- The PM material shows rotation of the α-lamellae
- The PM alloy exhibits increase of crystallographic misorientation within grains leading to subgrain formation in the β-phase

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