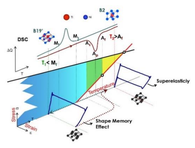


Workshop on Shape Memory Alloys
Processing, Properties and Applications
CENIMAT, FCT/UNL, 19/02/2020

Thermomechanical Behaviour Of Shape Memory Rivet In Situ Study

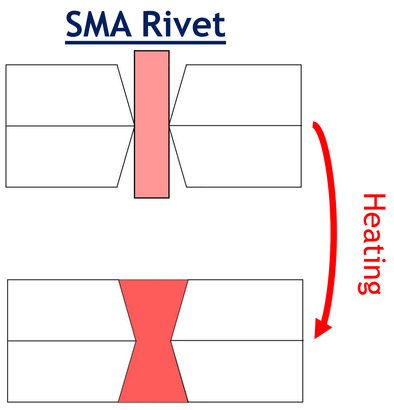
F. M. Braz Fernandes[1*], Edgar Camacho[1], Patrícia F. Rodrigues[1], Norbert Schell[2]

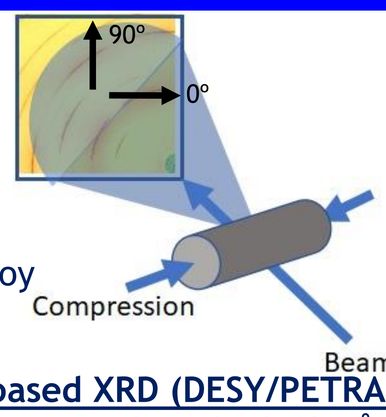
[1] *CENIMAT-I3N, FCT/UNL, Caparica, Portugal*
[2] *HZG / PETR-DESY, Hamburg, Germany*

ABSTRACT

A Ti-rich NiTi shape memory alloy (SMA) was used to join two components through shape memory effect adapted from the principle presented by a recent patent [1] that opens interesting perspectives in the field of aeronautics. In the concept study and viability of such type of rivet, DSC, dilatometric and in-situ XRD during thermomechanical cycles were performed [2]. In situ XRD study during thermomechanical cycle was conducted in a modified dilatometer DIL-805, Bähr at the HZG beamline (HEMS/P07-EH3, Petra III, DESY, Hamburg).

MATERIALS AND METHODS



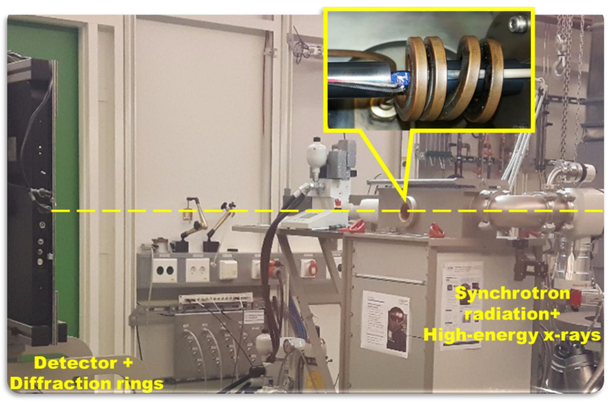


Material: Ti-rich NiTi alloy

Equipments:

Synchrotron radiation based XRD (DESY/PETRA III, Germany)

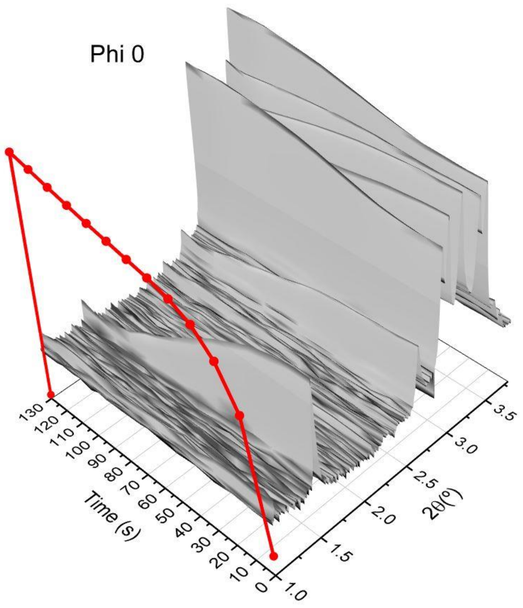
- Spot size: 200 x 200 µm; wavelength: 0.124 Å (98 keV)
- modified dilatometer DIL-805 (Bähr)

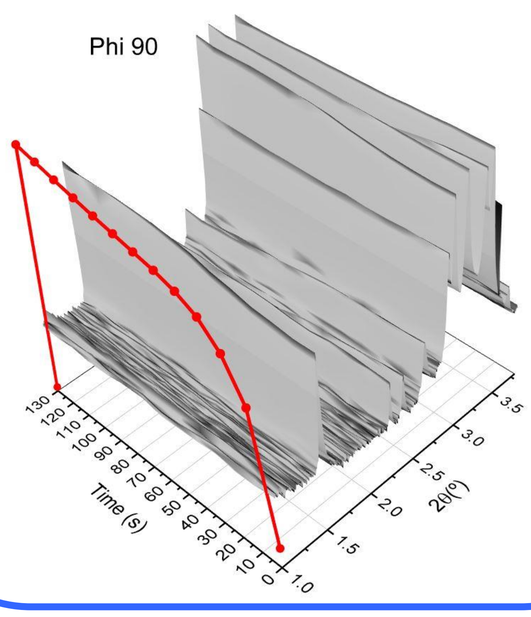


Schematics of the beam direction, dilatometer and part of inside the equipment and the position of the detector in relation of the sample.

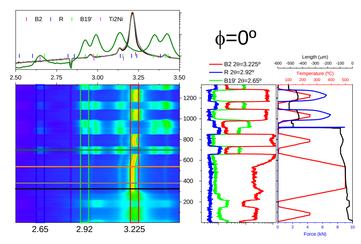
RESULTS AND DISCUSSION

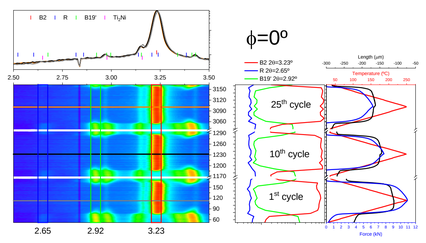
Deformation at room temperature

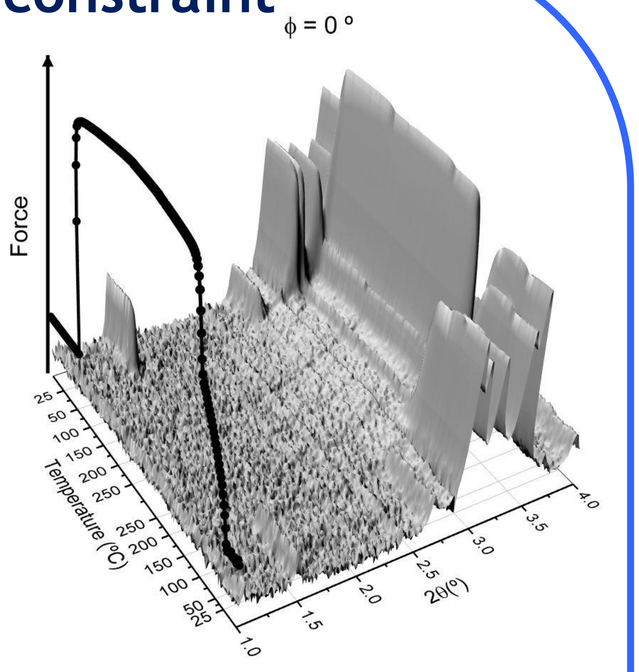


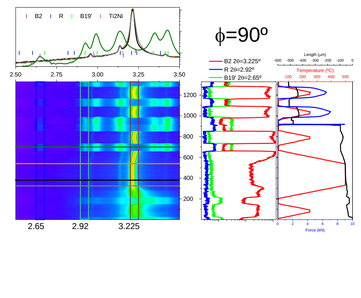


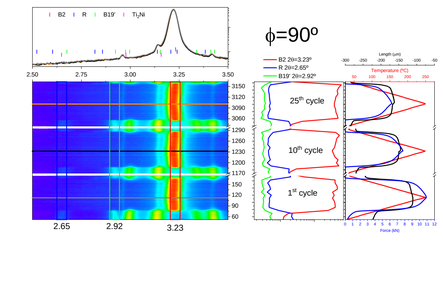
Actuation force under constraint

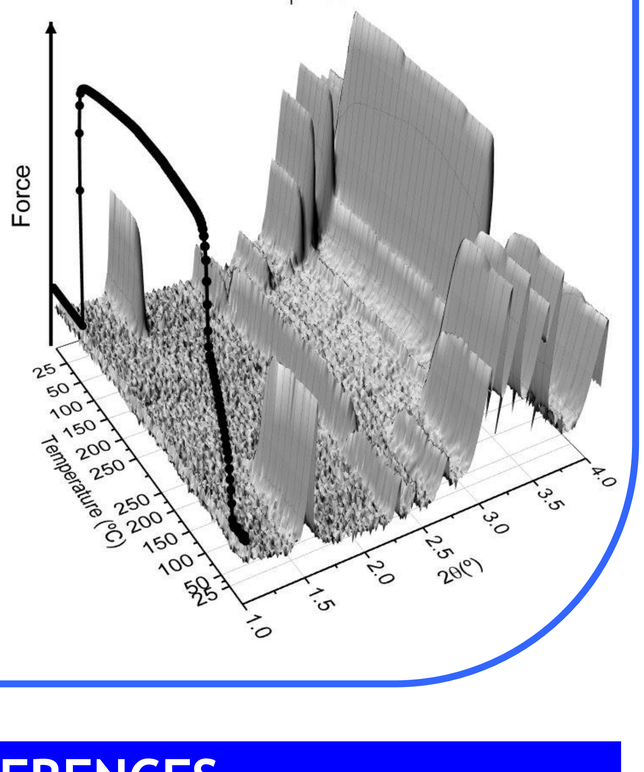


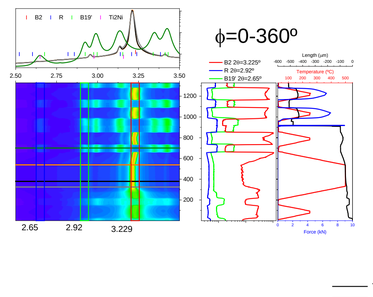


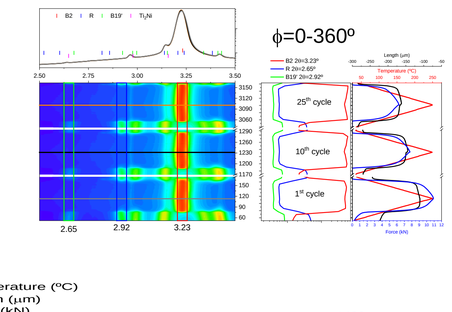


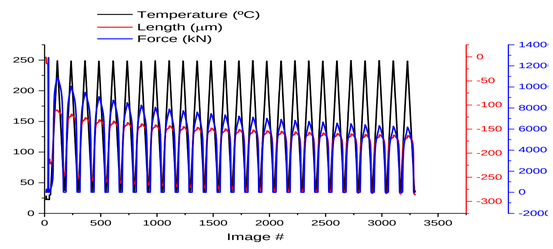












Actuation force of 6 kN at the 25th heating/cooling cycle

CONCLUSIONS

The maximum recovery after ~15% compression reached 4.2%.. Thermal hysteresis increases after the deformation (15% compression) of the samples. For the proof of concept, a sample of 5x5.5x5.5 mm^3 was used, where pull-out tests were performed to simulate the separation of 2 plates (4 mm thick) of aluminum. A maximum force of 340 N has been reached before separation. Also, the actuation force by SME promoted a localized strain hardening of the joined material, hence improving the contact interface between rivet and joined components.

REFERENCES

1. Kirkwood, B.L. et al., Self Expanding Fastener, US Patent 8.918.978 B2, 2014.
2. Camacho, E., Aplicação de ligas com memória de forma para rebites, MSc thesis (written in Portuguese), FCT/UNL, Caparica, Portugal, 2016.

ACKNOWLEDGMENTS

DESY
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