Multi-scale analysis during the mechanically-induced martensite phase transformation by synchrotron radiation and neutron diffraction.

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Thermomechanical properties of shape memory alloys (SMA) derive from the thermoelastic Martensitic Transformation (MT) and depend on the crystal structures of the phases involved in the transformation process. MT in SMA such as Cu-Al-Be can be induced and controlled by external stress and temperature. The transition is accompanied by the reversible evolution of large high successive inelastic strains which leads to the well-known phenomena of shape memory effect or superelasticity in thermomechanical loads. Strain compatibility at grain boundaries and redistribution of stress among grains of transforming polycrystal may impose very strong obstacle for the transformation in polycrystalline state [1]. This redistribution affects significantly its overall macroscopic stress-strain-temperature behavior and the superelasticity decreases from 10% for single crystal to 5% for polycrystalline alloys.

This paper focuses on the study of the superelastic behavior associated to stress induced martensite transformation in a Cu-12%Al-0.5%Be [wt. %]. The aim is to relate the mechanical and metallurgical states of these SMAs with the complementarities between Synchrotron radiation and Neutron diffraction on three different length scales.

- The first step involves the analysis of small-grain alloys in order to obtain average data of the bulk volume for the austenite phase on SALSA at ILL (Figure1).
- The second step takes us down to the scale of the grain aggregates with a study of the strain state along the tensile specimen on ID31 at ESRF
- In a third and final step, we will measure the evolution of the rotation in some individual grain with different orientations in relation to the tensile direction on ID11 with the 3DXRD method at ESRF

[1] K. Bhattacharya, R.V. Kohn. Acta Mater.44 (1996) p.529.

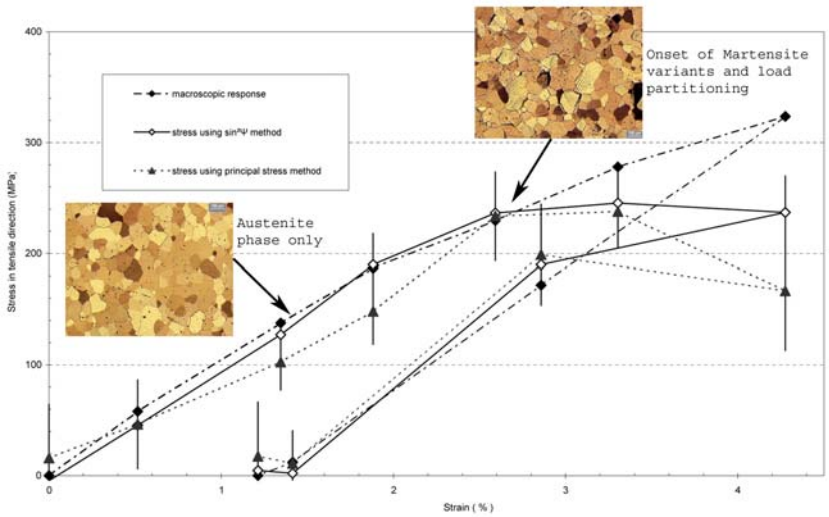

Figure1: Stress – Strain graph: Comparison between the macroscopic and the austenite stress state