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Proposal Title: Martensitic transformation in a grain embedded of a CuAlBe shape memory alloy polycrystal under loading.

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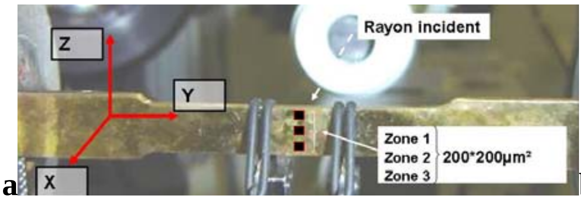
INTRODUCTION

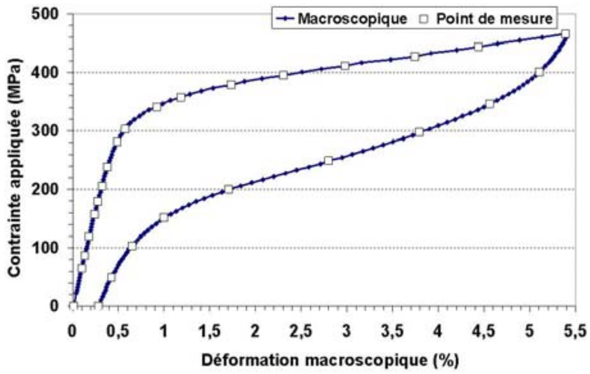
The goal of the experiment was to analyse the behaviour of the austenite inside a grain during the martensitic transformation induced by applied stress. The 3DXRD method was used on the beamline ID11. One of the originality for this work was to adapt the 3DXRD method to follow the austenitic during her transformation into martensite.

METHODE D'ANALYSE

The tensile sample in CuAlBe had grains with millimetric sized. The central part of the sample was analysed in. The fig.1a shows the coordinate reference, the three zones analysed with a beam of 200µm*200µm. The measurements were done along a pseudoelastic cycle (fig.1b).



a

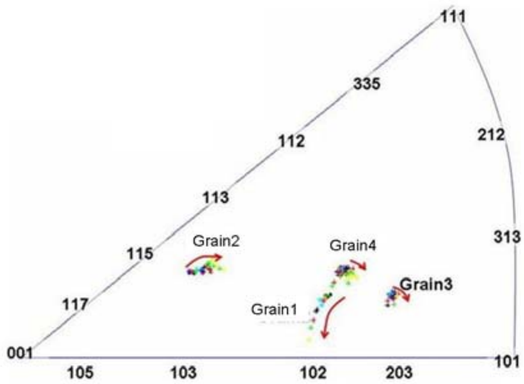


b

Fig.1a/ *Tensile sample with the coordinate reference (X, Y and Z) and the three zones analysed;*
b/ *The macroscopic stress-strain curve during the ID11 experiment.*

RESULTATS

Two important results were measured on 4 different grains during the pseudo-elastic cycle. The first was the rotation of the austenite during the load (fig.2a) and the rotation back during the unloading (fig.2b) with a residual rotation between the first and the last load point.



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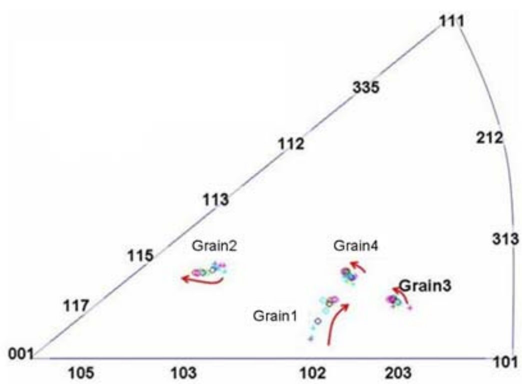

b

Figure 2a*: Rotation of the austenite during the load from 0MPa to 465MPa (0% à 5.5%).*
b*: Rotation back of the austenite during the unloading 465MPa to 0MPa (5.5% à 0.3%).*

The fig.3 shows the second important result. The creation and the evolution of the orientation of some small austenitic domains were observed when plates of martensite appear.

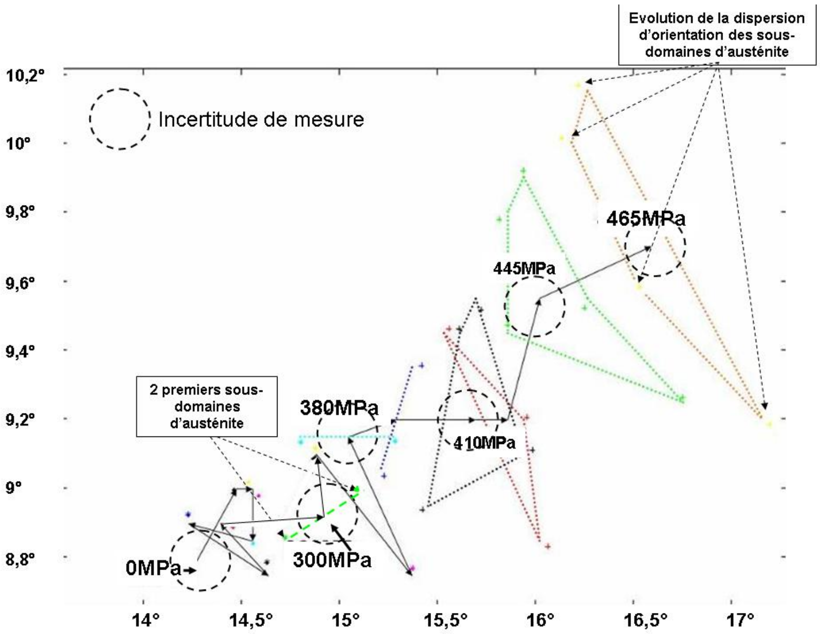

Fig. 3: *Zoom of the evolution in the orientation of the grain2 with the arrival of some domains during loading from 0 to 465MPa.*

Tableau 1 shows the evolution of the dispersion of orientation during the loading for the 4 grains.

Grain	**1**	**2**	**3**	**4**
Schmid factor	0,45	0,49	0,41	0,41
Stress of the first arrival domains $\sigma_i^{app.}$ Order	340MPa 2^{sd}	300MPa 1^{st}	360MPa 3^{rd}	360MPa 3^{th}
Maximal dispersion at 360MPa	0,3°	0,5°	0,6°	0,6°
Maximal dispersion at 410MPa	×	0,7°	0,8°	1,1°
Maximal dispersion at 430MPa	×	0,8°	1,0°	2,0°
Maximal dispersion at 445MPa	×	0,9°	×	2,2°
Maximal dispersion at 465MPa	×	1,5°	×	1,8°

Tableau 1*: Evolution of the dispersion for the 4 grains during the loading. × corresponds of the disappearance of the austenitic domains*

The order of the apparition of the domains corresponds with the inverse order of the Schmidt factor as expected. We obtain: $\boldsymbol{\sigma}_1^{app.}.\boldsymbol{R}_1 \approx \boldsymbol{\sigma}_2^{app.}.\boldsymbol{R}_2 \approx \boldsymbol{\sigma}_3^{app.}.\boldsymbol{R}_3 \approx \boldsymbol{\sigma}_4^{app.}.\boldsymbol{R}_4 \approx 150$.

Moreover these small domains disappear during the loading.

CONCLUSION

These news results observed can explained the widening of the Full Width Half Maximal of the peaks obtained by neutrons diffraction. The creation and evolution of small diffracting domains can also traduce the heterogeneity of the stress call intra-granular stress during a pseudo-elastic cycle. The experiment on BM32 (32 02 663) has to confirm these results.