



HAL
open science

Understanding crystallographic effects on strain localization in a 6016 aluminium alloy under plane strain tension using correlative X-ray lab tomography

Maryse Gille, Henry Proudhon, Jette Oddershede, Thilo F. Morgeneyer

► To cite this version:

Maryse Gille, Henry Proudhon, Jette Oddershede, Thilo F. Morgeneyer. Understanding crystallographic effects on strain localization in a 6016 aluminium alloy under plane strain tension using correlative X-ray lab tomography. XVII International Conference on Computational Plasticity, Sep 2023, Barcelone, Spain. hal-04345220

HAL Id: hal-04345220

<https://hal.science/hal-04345220>

Submitted on 14 Dec 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License

UNDERSTANDING CRYSTALLOGRAPHIC EFFECTS ON STRAIN LOCALIZATION IN A 6016 ALUMINIUM ALLOY UNDER PLANE STRAIN TENSION USING CORRELATIVE X-RAY LAB TOMOGRAPHY

Maryse Gille^{†*}, Henry Proudhon[†], Jette Oddershede^{††} and Thilo F. Morgeneyer[†]

[†]MINES Paris, PSL University, Centre des Matériaux, CNRS UMR 7633
BP 87, 91003 Evry, France

E-mail: maryse.gille@minesparis.psl.eu*; henry.proudhon@minesparis.psl.eu;
thilo.morgeneyer@minesparis.psl.eu, web page: <https://www.mat.minesparis.psl.eu/>

^{††}Xnovo Technology ApS

Galoche Alle 15, 1st floor, 4600 Køge, Denmark

E-mail: joddershede@xnovotech.com, web page: <https://xnovotech.com/>

ABSTRACT

This work aims at understanding the effects of grain structure on strain localization leading to failure when stamping a 6016 aluminium alloy sheet. A miniaturized plane strain tensile specimen inspired by Park et al. [1] was designed to study this critical strain state for formability. After obtaining the three dimensional grain map in the central region of the specimen with Diffraction Contrast Tomography (DCT) non-destructively [2], an *in situ* tensile test imaged by Absorption Contrast Tomography (ACT) was then carried out in 12 increments up to fracture (see Figure 1).

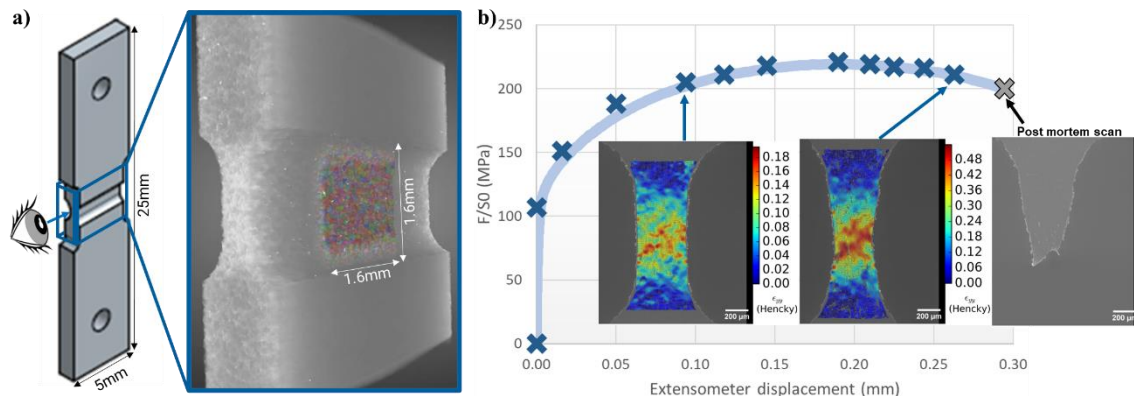


Figure 1 – a) Plane strain tension specimen before straining with the grain map obtained by DCT; b) Loading curve indicating the location of the 12 *in situ* ACT scans (blue crosses). Evolution of the strain field in tension direction ϵ_{yy} is displayed for 2 steps and can be compared with the location of final fracture shown on the *post mortem* scan.

The projection-DIC technique is used to compute the real internal strain field in the specimen. A heterogeneous strain field with localization bands and matching fracture location is revealed (see Figure 1.b). Subsequently, a crystal plasticity simulation performed on the complete grain map of the specimen provides the simulated internal strain field. A comparison between simulated and experimental results is made.

REFERENCES

- [1] N. Park, T. B. Stoughton, and J. W. Yoon, ‘A new approach for fracture prediction considering general anisotropy of metal sheets’, *International Journal of Plasticity*, vol. 124, pp. 199–225, 2020, doi: 10.1016/j.ijplas.2019.08.011.
- [2] F. Bachmann, H. Bale, N. Gueninchault, C. Holzner, and E. Lauridsen, ‘3D grain reconstruction from laboratory diffraction contrast tomography’, *J Appl Crystallogr*, vol. 52, Jun. 2019, doi: 10.1107/S1600576719005442.