Science et Ingénierie
des Matériaux et des Procédés
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Material Science - PhD Position

Mecanics of metallic glasses : from heterogeneous to homogeneous deformation.

Context

Metallic glasses (or amorphous metallic alloys) are among the least known metallic materials. They have exceptional mechanical resistance and their great shaping capacity give them valuable applications in various fields, such as MEMS, biomaterials or the watch industry. A collaborative project, financed by an ANR-DFG program (Franco-German) involving 2 German and 3 French laboratories, focuses on a study object of fundamental importance : the transition between heterogeneous plastic deformation and homogeneous plastic deformation (Figure 1) which is currently poorly understood

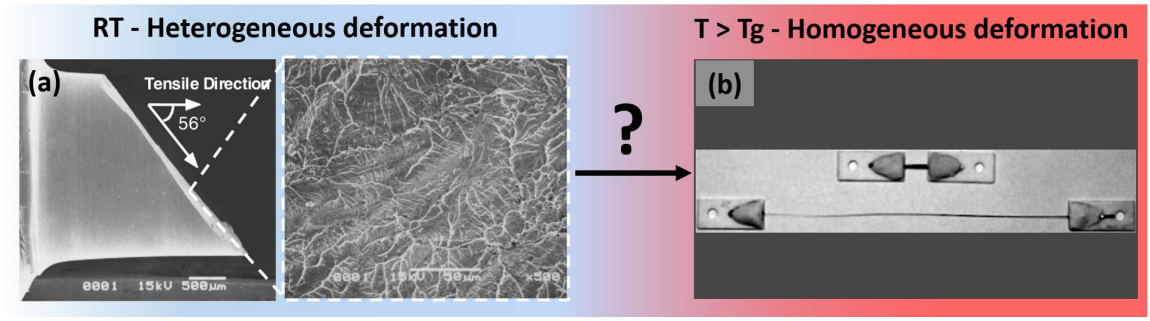

FIGURE 1 – Scanning electron microscopy image of a metallic glass sample deforemd in tension (a) at room temperature : heterogeneous deformation, failure and fracture surface, and (b) above the glass transition temperature : homogeneous deformation, high plastic deformation capacity without fracture. The mechanisms at the origin of this transition between the two domains remains relatively unexplored to date.

Research work

In order to study the fundamental underlying mechanisms that control this transition, the strategy consists in coupling experimental and theoretical analyses that will be carried out within various theses funded by the project. In particular, the work carried out at SIMaP, which is essentially experimental, will focus on tensile tests in temperature, notably *in situ*, in a scanning electron microscope on samples whose surface will be composed of a speckle. This technique, already used for example to evaluate the local deformation in crystalline magnesium samples (see Figure refFig2), will allow to trace the local deformation fields within the different samples. Additional microstructural (DSC, XRD, optical, TEM, etc.) or mechanical (nano-indenation, compression, bending, etc.) analyses will also be performed.

This approach, coupled with the other theses of the project, should reveal important mechanisms of the heterogeneous-homogenous transition and thus considerably improve the theoretical understanding of the deformation of amorphous metal alloys.

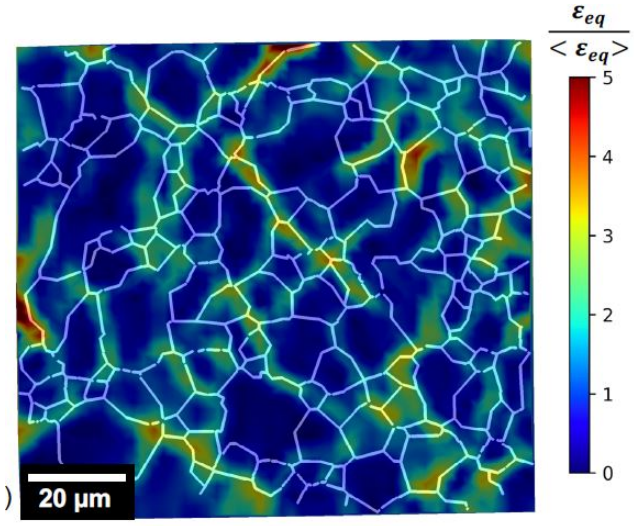

Figure 2 – Example of a local deformation map for a magnesium sample deformed in tension at 300 C. In this example, the deformation map is superimposed on the image of the grain boundaries obtained previously by EBSD analysis.

Compétences

Competence in materials science (mechanics & microstructures) is expected as well as a taste and aptitude for experimental work. We are looking for enthusiastic candidates who demonstrate a proactive attitude towards materials science/materials physics research. Candidates should have a strong interest in collaborating with international partners and therefore a level of English (written and spoken) consistent with this interest.

Informations complémentaires

- **Location :** SIMaP Laboratory, Groupe Génie Physique et Mécanique des Matériaux.
- **Duration** : 36 months.
- **Collaborations** : University of Munster, University Düsseldorf, Institut des Sciences de la Mécanique et Applications Industrielles (IMSIA), Laboratoire Mécanique des Sols, Structures et Matériaux (MSSMAT).
- **Salary** : ANR fundings (1700 € net per month + possibility of teaching) availability possibilités d'enseignement).
- **Contacts** : Rémi Daudin - remi.daudin@simap.grenoble-inp.fr, Jean-Jacques Blandin - jean-jacques.blandin@simap.grenoble-inp.fr