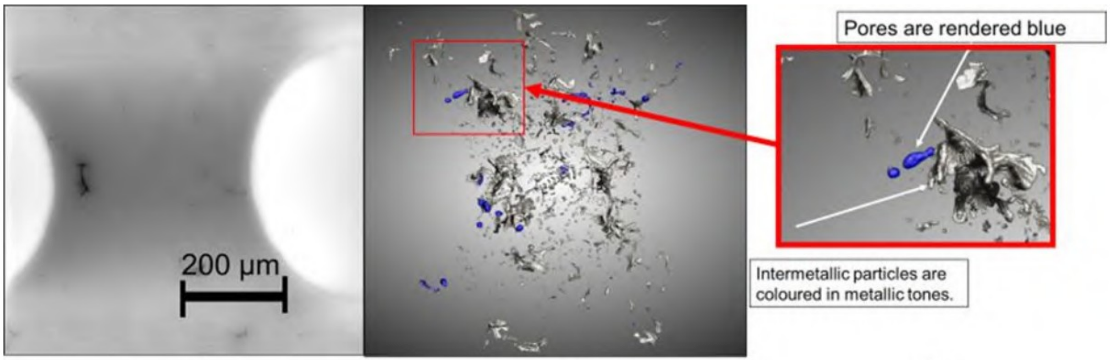
Communauté UNIVERSITÉ Grenoble Alpes

SIMaP

Influence of microstructure and local heterogeneities on the damage of aluminum alloys.

Hot forming processes of metallic alloys used for shaping and obtaining finished products induce very intense and heterogeneous mechanical fields that can lead to local damage. This is a crucial issue for industry, which is constantly seeking to optimize its processes and improve the quality of the finished products.
To tackle this problem, a macroscopic mechanical approach is generally used, but recent thesis work at the SiMaP laboratory has shown the limits of this approach and the need to take into account microstructural (precipitate, second phase) and micromechanical heterogeneities at microscopic scales.

The aim of this thesis project is to identify the contribution of microstructure, local crystallography and local stress fields to hot damage mechanisms in an aluminum alloy by exploiting a recent multi-scale 3D characterizations using correlative imaging enhanced by numerical simulation.



The alloy chosen for the study is aluminum alloy 2050 supplied by Constellium.
The thesis work will be based on two 3D characterization methods: (i) in-situ nano-tomography during hot tensile tests, and dual-beam electron imaging using serial sections (PFIB Xe Helios) and (ii) a numerical modeling method for calculating local stress fields.

The first part of the work will consist of three-dimensional, multi-scale characterization by correlative imaging, using a combination of 3D images obtained by nanotomography (ID16B ESRF) and PFIB. Analysis of the 3D images obtained will provide morphological characteristics of the pores and surrounding microstructure.

Secondly, this 3D microstructural information will be used to calculate local stress fields, taking into account the actual microstructure. A numerical code based on fast Fourier transforms (FFT) will be used, as this method enables 3D images of microstructure and porosities to be integrated directly. The thesis will be carried out at the SiMaP laboratory, and the topic will give rise to collaborations with ESRF (European Synchrotron Radiation Facility) and the company Constellium, leader in high value-added aluminum alloys.

The candidate will hold a Master's degree or equivalent in materials science, mechanics or physics. Knowledge in metallurgy is required, and notions in characterization (microstructure and mechanics) are a plus. Basic programming experience (Python/Matlab or equivalent) is desirable. The candidate will be expected to take initiatives for experimental procedures and image processing. The candidate should have a strong motivation for research work, a taste for experimental work, 3D image processing and electron microscopy. The candidate must be able to work in a team.

To apply : BEFORE the 17th of May (and as soon as possible) send a CV and a motivation letter to :
Emilie FERRIE, emilie.ferrie@simap.grenoble-inp.fr et Luc SALVO luc.salvo@simap.grenoble-inp.fr