**PhD position in 3D X-ray diffraction imaging applied to study of plastic deformation and material micromechanics**

**INSA Lyon & ESRF Grenoble (France)**

## Context: the project 3DiPolyPlast

Understanding the deformation processes leading to the failure of polycrystalline structural materials is one of the key challenges in materials science. Significant progress has been achieved over the past decades, thanks to both cutting-edge experimental characterization techniques and computational methods. Still, the localization of plasticity in slip bands and the propagation of plasticity through a polycrystalline aggregate are not fully understood. The investigation of such phenomena is the goal of the ANR project 3DPolyPlast starting in 2020. The key objectives of this project are:

1. Pushing the frontier of experimental characterization of bulk plasticity
2. Determining the contribution of slip band/localization in plastic strain of individual grains
3. Identifying mechanisms governing the propagation of plastic strain in the polycrystal
4. Advancing image-based mesoscale modelling of crystal plasticity

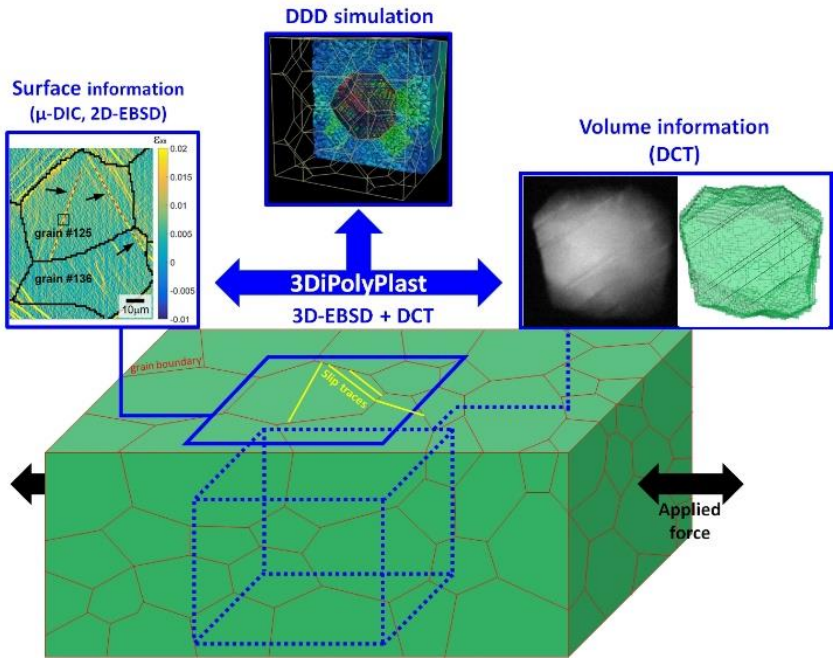


Figure 1: Schematic of the concept of the 3DiPolyPlast project, combining state-of-the-art experimental and simulation techniques into a multi-scale study of the plastic strain localization and propagation in a polycrystalline material.

## Project description

Over the last years, a number of X-ray diffraction based characterization techniques have reached a level of maturity that enables us to interrogate microstructural variables (i.e. local orientation, elastic strain, damage) in the bulk of 100µm up to 1mm sized polycrystalline sample volumes. With the upgrade of the ESRF storage ring these observables can now be monitored **in-situ** and in the **bulk** of metallic samples during early stages of plastic deformation.
The candidate will contribute to the development and further optimization of tomographic data collection schemes for the study of plastic strain localization using a combination of different **3D synchrotron X-ray diffraction imaging techniques** (3DXRD).

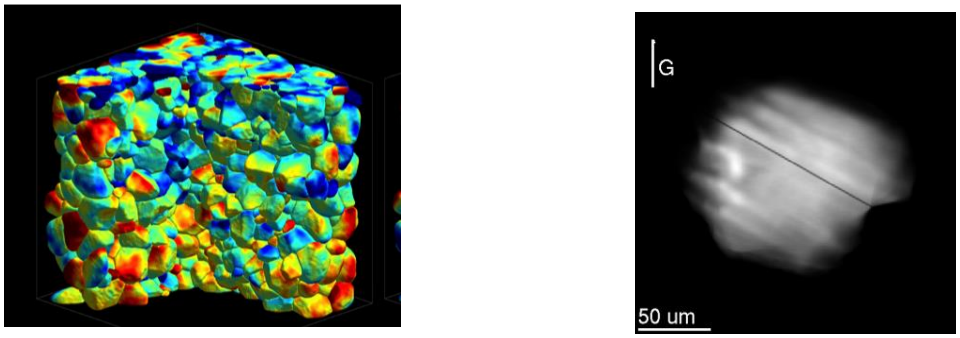


Figure 2: left) 3D reconstruction of a polycrystalline sample using synchrotron X-ray diffraction imaging techniques. Right) 2D projection image of a grain exhibiting strain localization (slip bands)

The optimization will initially be carried out on synthetic test data and then be transferred into an experimental protocol enabling sub-micrometre spatial resolution orientation and strain mapping in the bulk of deforming metallic microstructures. Programing of automated data reduction schemes including projection alignment, tomographic reconstruction and post-processing of reconstructed 3D orientation and strain fields will prepare the basis for a series of in-situ observations during tensile testing of metallic polycrystals. The ultimate goals is to create 3D movies of orientation and strain fields, and to analyse the progressive localization and propagation of plasticity in polycrystalline materials.

**Candidate**: We are looking for a highly motivated student with a master degree in physics or materials science. The candidate should have great interest in and experience with one or more of the following topics: digital image processing, inverse problems or X-ray diffraction. Programming skills in Matlab or Python will be required. French language skills are welcome but not obligatory. The candidate should have good communication skills and team spirit. The project is aimed to start in summer / autumn 2020. Applications should include a motivation letter, and two support letters of his/her professors and details about courses / classes / grades. They should be addressed to:

**Practical information:**
Duration: 36 months, starting in 2020
Funding: ANR Project 3DiPolyPlast
Location: ESRF, Grenoble, France
Doctoral school: Materials http://ed34.universite-lyon.fr/

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