**Advanced dislocation dynamics simulations to model irradiation effects on crystal plasticity**

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Neutron irradiation of steels used for both fission and fusion applications leads to the formation of a population of nanometric defects. These radiation-induced defects interact in turn with the dislocations contained in each grain, therefore modifying the plastic behavior at the microscale. The link between these elementary interactions and the macroscopic consequences of irradiation, hardening, flow localisation and embrittlement, is however still unclear and is the topic of numerous multiscale investigations.

This post-doctoral study aims at a better understanding of the mechanical behavior of irradiated steels at the microscopic/mesoscopic scale using Dislocation Dynamics (DD) simulation, which is nowadays a well-established computer method to investigate the roles of dislocation processes in a representative volume element of metals. DD simulations are therefore relevant to understand how elementary dislocation-defects interactions influences the plastic behavior at the grain scale. Such simulations require unfortunately a number of degrees of freedom which is beyond the possibilities of most DD codes.

This limitation can be overcome using the Discrete-Continuous Model (DCM) [1-2] developed at the LEM by coupling DD to AMITEX\_FFTP, a distributed parallel elastic solver based on Fast Fourier Transform calculation developed at CEA Saclay [3]. Using this new approach, the stress state definition in the simulated volumes could grow from grid 64x64x64 to 1024x1024x1024, hence allowing the simulation of realistic volumes over significant plastic strains. An initial version of this coupling has been successfully implemented with the DD code developed at CEA Saclay [4-5]. Further testing and benchmarking is however still required as the first step of this post-doctoral study. Depending on its actual computational efficiency, further optimizations may be required : in particular, it is likely that this coupling will have to be extended to the parallel version of the DD code. Finally this coupling will be used to simulate and understand the mechanisms leading to flow localization in irradiated materials.

**Expected results:**

* Testing and optimization of the Discrete-Continuous model with the massively parallel solver AMITEX\_FFTP.
* Large-scale simulation of a 3D grain containing a representative density of radiation-induced defects.

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**Selected references:**

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