PhD position at Groupe de Physique des Matériaux, Université & INSA de Rouen, CNRS UMR 6634

Interactions between plasticity, viscosity and microstructure evolution in a steel subjected to diffusive phase transformation

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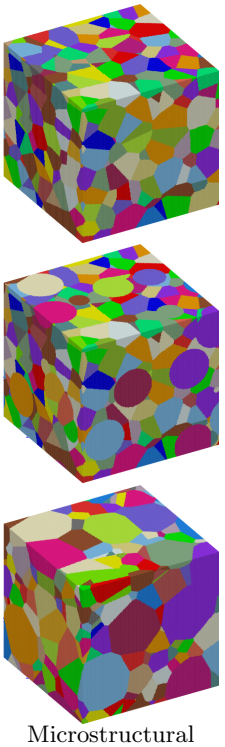
Starts on october 2011

Context Among the phenomena that can affect the mechanical properties of steels (its performances, life expectancy ...), the plasticity induced by phase transformation (TRIP) and the transmission of hardening from the parent to the product phase constitute particular problems which require dedicated micromechanical models. These models provide reasonable predictions of TRIP as compared to experimental observations at the macroscopic scale but the accounted mechanisms are based on homogeneity hypothesis concerning phase properties as well as mechanical fields. Consequently they cannot be used for studying accurately the interplay between local phases interactions and the evolution of a crystalline microstructure, which is a key issue for many multi-physics problems such as material processing, life estimation of structural components subjected to severe conditions...

Research program Our recently developed numerical modelling [1] addresses the problem of 3D polycrystal-to-polycrystal diffusive phase transformations by accounting for the principal physical and mechanical characteristics of phase transformations in steels: random microstructural morphology, crystal plasticity, transformation kinetics, viscosity. It has been evaluated by cross-comparison with experimental measures and other models [2]. This PhD study will consists in developing the modelling by enriching the aforementioned characteristics according to two directions: *(i)* concerning the constitutive laws that govern phases behaviours, at the light of new experimental mechanical tests; *(ii)* in the field of physics of phase transformation, by introducing thermodynamics-based modelling for the determination of the kinetics of phase transformation on a local intracrystalline scale. Two teams having complementary expertise will be in charge of the supervision: ERMECA for the mechanics part, ER3M for microstructural evolution. Additional directions will be provided by R. Quey from Ecole des Mines de Saint Etienne, in the continuation of our long-term collaboration.



Microstructural evolution in a polycrystal, after [1]

Candidate profile Qualifications and requirements are an MSc degree in engineering mechanics or computational materials science. Competence and experience in a large subset of the following: plasticity of materials, FE modelling, programming languages (f90, C, C++, ...), solid-solid phase transformations. Good level either in french or english is required.

Contact

Please send applications in french or english (including CV, cover letter and if possible references) to Fabrice Barbe (fabrice.barbe at insa-rouen.fr, +33 2 32 95 97 60), Nicolas Lecoq (nicolas.lecoq at univ-rouen.fr) and Lakhdar Taleb (lakhdar.taleb at insa-rouen.fr).

References

[1] Barbe, F., Quey, R., A numerical modelling of 3D polycrystal-to-polycrystal diffusive phase transformations involving crystal plasticity. *Int J Plasticity*, In press, doi: 10.1016/j.ijplas.2010.09.008
[2] Tahimi, A., Barbe, F., Taleb, L., Quey, R., Guillet, A., Evaluation of microstructure-based transformation plasticity models from experiments on 100C6 steel, *Comput Mat Sc*, In press, doi: 10.1016/j.commatsci.2011.01.05