Globularization phenomenon in α/β titanium alloys: experimental analysis and numerical modeling

MINES ParisTech

Cemef
CENTRE DE MISE EN FORME DES MATERIAUX

Metallurgy
μStructure
Rheology

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TIMET

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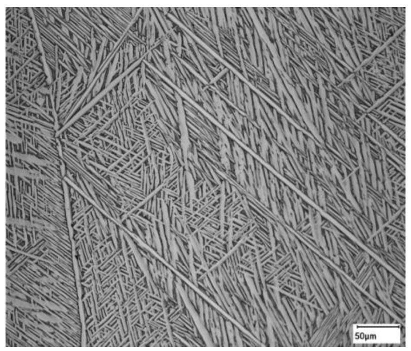
Objectives:

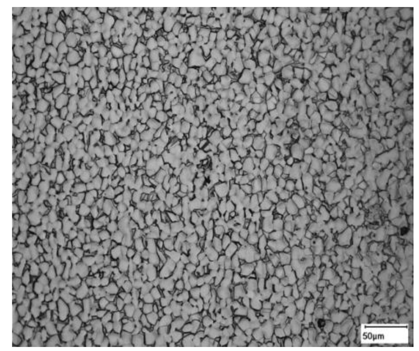
- create a numerical model in order to represent two-phase lamellar microstructures and simulate the phenomenon of globularization
- produce experimental results to improve the understanding of the mechanisms and validate numerical results

α/β titanium alloy



Initial microstructure

Hot deformation + Thermal treatment →



Globularized microstructure

Experimental analysis

Producing experimental results in order to understand the basic mechanisms of globularization and comparing them with our numerical ones

Numerical Modeling of Globularization

Simulation of Basic Mechanisms

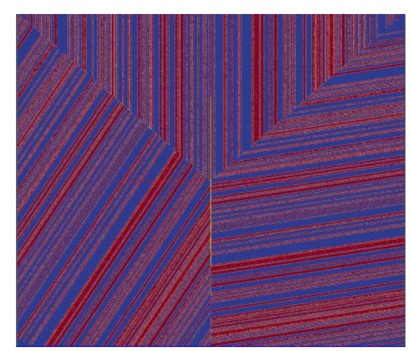
- **Deformation**
- **Motion by surface diffusion**
- **Motion by mean curvature**
- **Volume diffusion**

Level Set Formulation

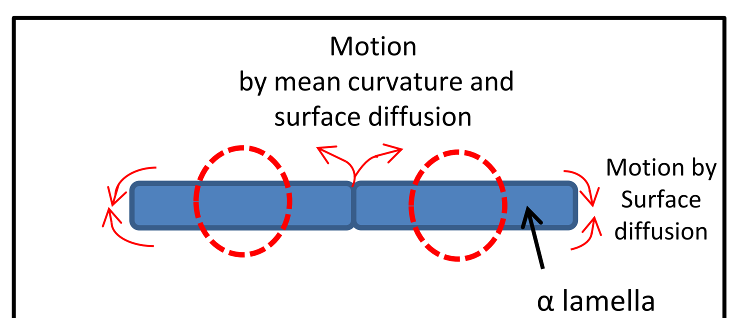
$$\Gamma(t) = \{\underline{x} \in R^n, \varphi(x,t) = 0\}$$

$$\varphi(x,t) = \begin{cases} -dist(x,\Gamma), x \in \omega \\ dist\,(x,\Gamma), x \notin \omega \end{cases}$$

$$\partial_t \varphi + \overrightarrow{\boldsymbol{v}}\,\overrightarrow{\nabla \varphi} = 0$$



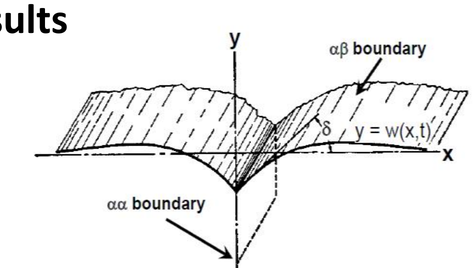
Level Set description of colonies



Lamella splitting

Ongoing work

- **Create a numerical model in order to predict efficiently the phenomenon of globularization**
- **Develop a biphasic crystal plasticity finite element model (CPFEM)**
- **Model the different mechanisms that govern globularization phenomenon**
- **Produce additional experimental data for comparison with the numerical results**



Formation of a groove