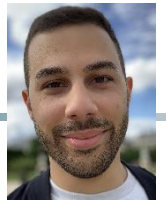


***Maxime MONZEY***
Thèse (ANR), 2018 – 2021
MATEIS (Patrice CHANTRENNE & Damien FABREGUE)


# Study of electromigration in metallic alloys

Équipe Métal

## Context

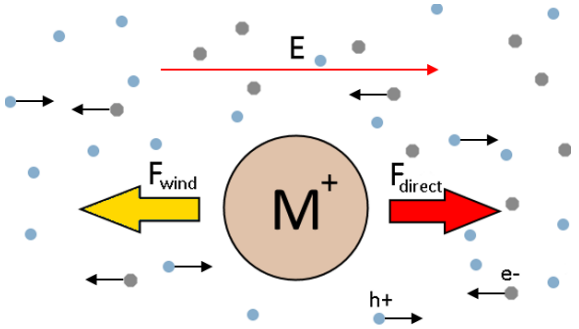
### Heat treatment of metallic alloys :

- Classic: conduction, radiation
- **Joule effect**: spot welding, induction (ex: Gleeble, SPS)

### Electromigration

= movement of particles induced by electric current

= Coulomb force due to applied field + electron-ion and hole-ion collisions

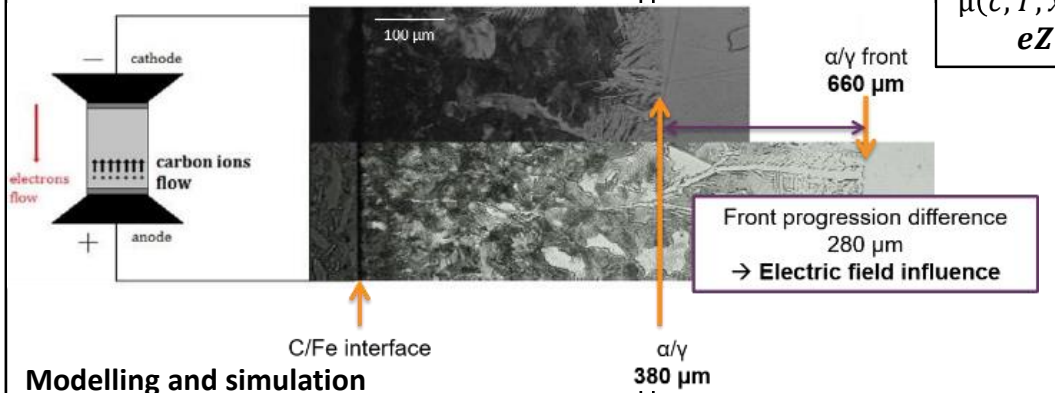



**What influence has electric current on diffusion of metallic species ?**

## Method and tools

### Characterisation

- Optical microscope
- Scanning Electronic Microscope
- Microsonde
- Micro-hardness




### Modelling and simulation

- Nernst-Einstein model
- 1D diffusion calculations
- Thermodynamics modelling

### Experimental

- SPS
- Electromigration studying furnace

## Results

### Study of binary system Fe-C in intercritic domain → phase transformation

- Interpretation of electric current as an additionnal energy **modifying chemical potential of species** :

$$\mu(c,T,x) = \mu_0 + RTln(c) + eZ^*N_AV(x) \text{ (J/mol)}$$

**$Z^*$ effective charge of activated metallic ion**
Depends on temperature, current density and concentration

**Electric field may induce new phasis equilibrium!**
→ Fit of SPS data with new chemical potential
→ Experimental plan to explore behaviour variations with parameters