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Research topics:

- Martensitic Phase Transformations in Fe-C Alloys
- Micro-Mechanics of Phase Transformations
- Cellular Automata Modelling

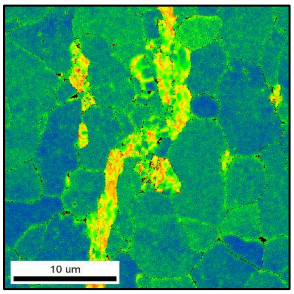
Modelling Martensite Formation and Associated Stresses in DP Steels

Research activities:

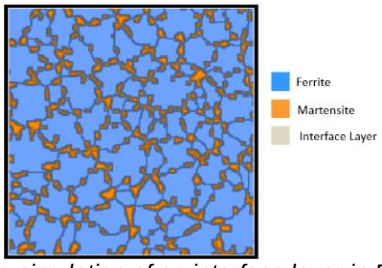
Background: Ferrite-Martensite dual phase (DP) steels show an excellent combination of strength and ductility. Their characteristic mechanical features such as continuous yielding, low yield point and high initial work hardening rate are believed to be caused by pre-existing internal stresses in the ferrite grains which are induced by volume expansion during austenite to martensite transformation. In order to predict mechanical behaviour of DP steels accurately, it is important to include these internal stresses in the predictive models.

State of the Art: A complete description of the formation of martensite in steel for predictive purposes should consider the thermodynamics involved in the process, the martensite morphology and hierarchical microstructure, the surrounding phases (ferrite in the case of dual-phase steels) and the micro-mechanical features involved in the formation of the product martensite phase from the austenitic matrix. At the moment, there are no models able to describe all these aspects of the martensitic transformation combined. Although, individually they have been addressed and researched.

Approach in Current Research: It involves estimating the spread of internal stress field in ferrite grains by analysing accumulated geometrically necessary dislocations (GNDs) densities using EBSD measurements. This will be used to model the stress field in ferrite grains as a thin layer of strain hardened ferrite present at ferrite/martensite interfaces. Cellular Automata (CA) based framework will be used to model such a layer in DP steels.



An example showing GND spread in a DP steel microstructure



A simple simulation of an interface layer in DP steel microstructure using CA