Nucleation and grain growth in Fe-based alloys under magnetic field: some kinetics aspects

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Magnetic field processing is a promising method to control microstructures and improve functional properties in steels and other Fe-based alloys. With the increasing availability of intense magnetic fields, thanks to helium free superconducting magnet technology, new effects of magnetic fields have been brought to light and could be used in the near future in applications, such as the effect on phase equilibria.

Following the results on the thermodynamic stabilization of ferrite, some kinetics aspects of the ferrite formation are addressed in this presentation.

The effect of magnetic field on the austenite to ferrite transformation kinetics is studied in iron by means of dilatation measurements under magnetic field. In the frame of the Johnson–Mehl–Avrami-Kolmogorov analysis the Avrami exponent and the activation energy for the interface mobility are calculated. The nucleation kinetics is studied using magnetic measurements and image analysis.

In the second part of the presentation, the influence of magnetic field on ferrite recristallisation is demonstrated both in steels and in the $FeCo_{27}$ alloy. In this latter case, a crystal orientation selection takes place during annealing under field, from the early stage of the recrystallization and is responsible for a delay of the recrystallization process. Grain coarsening of the grains with preferred orientation is also enhanced.