Multi-scale characterisation of a micro-alloyed "trip-assited bainitic" steel

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Amphitheater Jean Besson

Jury :
- Mme Myriam Dumont, maître de conférences à l'université d'Aix-Marseille, rapporteure
- M. Sébastien Allain, professeur à l'université de Lorraine, rapporteur
- M. Mohamed Gouné, professeur à l'université de Bordeaux, examinateur

Abstract: 3rd generation Advanced High Strength Steels (AHSS) have the advantage of combining strength and ductility. These multi-phase steels are appreciated for applications in the automotive industry for their mechanical properties, notably due to the presence of metastable austenite allowing Transformation Induced Plasticity (TRIP effect).
The objective of this work was to study the effect of microalloying on phase transformations and precipitation in such steels. Three grades have been studied: a reference without microalloying, one with niobium addition, and one with vanadium addition. They have been characterised through the metallurgical route composed of an intermediate annealing, following by a final annealing characteristic of TRIP-assisted bainitic steels.
Both ex-situ and in-situ methods have been applied. In-situ characterisation during thermal treatments includes phase transformation study by High-Energy X-ray Diffraction (HEXRD) and precipitation study by Small Angle X-ray Scattering (SAXS), both performed with synchrotron radiation.
Grain morphology has been observed by optical microscopy and Electron Back-Scatter Diffraction (EBSD) in a Scanning Electron Microscope (SEM). Imaging of precipitates has been made in Transmission Electron Microscopy (TEM) via dark-field imaging, their composition has been evaluated by Energy Dispersive Spectroscopy (EDS) and their localization studied thanks to the nano-diffraction tool ACOM/ASTAR.
All these experiments made it possible to highlight the effect of heat treatment and chemical composition on the amount of austenite present and on its carbon content, which are the main parameters controlling the TRIP effect. The presence of the microalloying results in variations in these parameters, related both to the presence of precipitates containing these elements and to their presence in solid solution.