Abstract

Project Code: TRG5780214

Project Title: *Through Process Modelling of the Precipitation Optimization in Hot Rolled Microalloyed Steels*

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Project Period: 2 June 2014 – 5 September 2016

To optimise the strengthening effect from the microalloying elements throughout the thermomechanical controlled process, a physically-based thermokinetic simulation as well as the synchrotron X-ray absorption spectroscopy (XAS) has been employed to study the influence of different parameters during the process on the precipitation. This brings about a significant advantage in terms of reducing the amount of experimental work. The mole fraction and size distribution of different precipitate species as well as the consumption of the dissolved elements are of the main interest. The model considers the involved parameters in the hot rolling process, i.e., austenite grain size, dislocation density as a function of deformation, and thermal history during the process. One main advantage is that it needs no adjustable fitting values. Both grain boundary and dislocation are nucleation sites. Although the long interpass time for the recrystallization times is applied, the dislocation density increases for 1 order of magnitude, compared with the equilibrium state. Slow cooling rate facilitates its precipitation significantly, especially at lower degree of deformation. These findings are crucial for the calculation of precipitation hardening, which must be evaluated with other strengthening mechanisms from the microstructure such as grain size, hard phase to discuss about the resulting mechanical properties.

The methodology of using the XAS for the quantification of the precipitation of vanadium as well as its fraction in the solid solution has been set up for other metals, when appropriate. This is quite new to use XAS in metallurgy although it is widely used in other groups of materials. The method is superior to other conventional method and illuminates relatively large volume and useful to compare the degree of precipitation from the simulation.

Keywords: 3-5 words
precipitation simulation, high strength low alloyed steel, hot rolling, vanadium, X-ray absorption spectroscopy