Hybrid computer system for through process modelling and prediction of microstructure of hot rolled high strength steel strips

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ABSTRACT

The *VirtRoll* computer system is a virtual representation of the hot strip rolling process [1]. It combines models, data and knowledge bases and inverse approach to design optimal technology. The new generation material models were implemented in the system in the micro scale and connected with the macro scale FE code. The motivation was the need for design of new grades of steels with improved mechanical properties. Multiphase steels have been widely used for deep drawing applications because they exhibit a superior combination of high strength and good ductility. Dual phase (DP) and complex phase (CP) steels are two most widely used grades in automobile industry. The DP microstructure is characterized by the fine ferrite matrix with dispersed hard islands of martensite. The mechanical properties of DP steel are influenced by the volume fraction and spatial distribution of martensite, as well as size of martensite islands and ferrite grains. On the other hand, the hardness difference between the ferrite and martensite causes stress concentrations and deteriorates local ductility. CP steel has fine microstructure with a heterogeneous mixture of bainite, martensite and ferrite. Compared with DP steel, the hardness differences between constituents are smaller, what makes CP steels more suitable for stretch-forming processes [2]. Thus, evaluation of gradients of mechanical properties became an important challenge in modelling of hot strip rolling. Development of the model, which can predict distributions of mechanical properties, was the main objective of the work. Two approaches were considered. In the first RVE with level set method was used to solve diffusion equation and create a map of micro hardness distribution. Screening methods used in the sensitivity analysis were applied to calculate gradients of properties. In the second approach the evolution equations were solved for stochastic variables. Distributions of the dislocation density and gain size were determined.

REFERENCES

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