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Editorial

Advanced Multiphase Steels

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1. Introduction and Scope

We are currently experiencing an increasingly fast development of new steel grades with complex multiphase microstructures attempting to give tailored answers to industrial demands. The combination of the dissimilar mechanical properties of the phases gives rise to a great variety of mechanical responses, which draws the attention of the academia and industrial communities. Those mechanical properties can be tuned with the help of ad hoc alloying and processing strategies. However, the state of the art on the relationships among properties, processing, and microstructure reveals that our knowledge is far from complete when two or more phases are involved. Improving microstructural and mechanical characterization techniques, models, and simulations to characterize, understand, and predict multiphase steels' phase transformation and mechanical behavior is critical to achieving optimized solutions. This Special Issue, "Advances in Multiphase Steels", aims to present the latest achievements in several aspects of multiphase steels of alloy design, processing optimization, and their final mechanical properties.

2. Contributions

The manuscripts gathered in this Special Issue are committed to a variety of steel grades, embracing DP (Dual Phase) steels [1], medium-Mn steels [2,3], CFB (Carbide Free Bainitic steels) [4], nano-bainitic cast steel [5], δ-TRIP (TRansformation Induced Plasticity) [6] and precipitation hardened ferritic stainless steel [7].

A wide range of topics are researched that comprise the alloy design [2,6,7], optimization of both the hot working process [2] and the final heat treatment [5], and the final mechanical properties [1,3,4,6].

When looking at the alloying effects, Mn content relevance both on medium-Mn steels [2] and on δ-TRIP steels [6] is analyzed in detail. The role of Nb additions is also tackled as an element that may control and optimize the hot rolling behavior [2], the microstructure development during the whole industrial process [1,2], and also enhance the mechanical properties [1,7].

The optimization of the final bainitic heat treatment is analyzed for nano-bainitic cast steel [5]

In references [3–6], the mechanical stability of the retained austenite during tensile testing is studied deeply, whereas its thermal stability upon final thermomechanical or thermal treatment is analyzed in [2,6]. It is a pivotal phase to optimize the mechanical behavior of various multiphase steels.

The application of advanced characterization techniques such as in situ EBSD (Electron Backscatter Diffraction) [6], high-resolution TEM (Transmission Electron Microscopy) [1,5], or HRXRD (High-Energy X-Ray Diffraction) [3] for the fine analysis of the final microstructures of the steels under static and dynamic conditions is remarkable.

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3. Conclusions and Outlook

Complex multiphase steels have been a topic of great interest for many metallurgists during the last years, as shown in the manuscripts included in this Special Issue. The optimized combination of the mechanical properties of the phases involved in the final product for the selected application can be achieved via an intelligent choice of tailored alloying and processing strategies. The bundle of works in this issue sheds light on aspects that move from hot working to final heat treatments for various steel grades. However, the insightful studies in this issue demonstrate that multiphase steels still require intensive and profound research to understand the basic mechanisms of phase transformation and further mechanical behavior via their connection to the process conditions. The degree of acceptance of the multiphase steels in industrial practice and under service conditions relies on this fundamental knowledge, which provides meaningful clues about their manufacturability, productivity, and range of final applicability.

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Conflicts of Interest: The author declares no conflict of interest.

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