

Editorial

# Mechanical Behavior of High-Strength, Low-Alloy Steels

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## 1. Introduction and Scope

High-strength low-alloy steels are designed to provide specific desirable combinations of properties, such as strength, toughness, formability, weldability, and corrosion resistance. These features make them ideal for critical applications under severe service conditions and in aggressive environments, namely rail and road vehicles, passenger car components, construction machinery, industrial equipment, offshore structures, gas pipelines, and bridges, among others. This Special Issue aims to address the mechanical behavior of high-strength low-alloy steels from different perspectives, namely in terms of mechanical deformation, damage, and failure. It gathers scientific contributions from authors working in various fields, for instance processing techniques, the modeling of the mechanical behavior, the characterization of material microstructure, the influence of environmental parameters, temperature dependence, as well as advanced applications.

## 2. Contributions

The modern automotive and rail industries are facing significant challenges in terms of weight reduction for fuel economy as well as in terms of mechanical properties to develop safer and more durable products. In this Special Issue, attention is paid to the relation of the final mechanical properties and the microstructural features. The paper by Branco et al. [1] provides an insight into the role of the bainitic morphologies in fatigue cyclic plastic properties; the paper by Liang et al. [2] studies the effect of phase fraction on deformation and fracture behavior in low-carbon ferrite-martensite steels; and the paper by Evin et al. [3] addresses the microstructure characteristics of the mechanical properties of dual-phase, high-strength steels.

Due to the incentives for the widespread use of natural gas as a source of clean energy, high-strength low-alloy steels have been one of the prime choices for high-pressure gas pipeline networks. In this context, knowledge of the microstructural and mechanical properties of such materials, as well as the development of accurate design and inspection methodologies is of major importance. Lavigne et al. [4] present a comprehensive study of the microstructural and mechanical characterization of API 5L X52 steel; Silva et al. [5] discuss the effect of precipitation and grain size on the tensile strain-hardening exponent of API X80 steel; Liu et al. [6] analyze the local buckling behavior and plastic deformation capacity of high-strength X80 steel pipelines subjected to strike-slip fault displacements; and Vilkys et al. [7] study the influence of mechanical surface defects on the safe operation of gas pipelines on the basis of fragments collected from operating parts.

The effect of aggressive environments on the design of engineering structures is also particularly important. This is well documented in the paper written by Krivy et al. [8], which examines the dependence between the deposition of chlorides and the corrosion layers of two steel bridges; or in the paper written by Cho et al. [9], which correlates hydrogen-induced corrosion cracking with

maintenance interventions in the wires of cable suspension bridges; or in the paper written by Cabrini et al. [10], which evaluates the critical ranges of pH for the initiation of stress corrosion cracking in high-strength steel bars for pre-stressed concrete structures.

Finally, another important topic is the fracture behavior of high-strength steels. Zhang et al. [11] investigate the brittle fracture of large press die holders following a systematic approach that encompasses chemical composition analysis, mechanical property testing, and microstructure examination of the critical area; Riyanta et al. [12] determine the fracture resistance of AISI 304 welding by Charpy impact testing, relating the values of energy absorption to the presence of chromium interstitial solute and chromium carbide precipitation. Last, but not least, Suárez et al. [13] review the recent experimental and numerical advances dealing with fracture mechanics in steels with a primary focus on flat-fracture surfaces.

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