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Editorial

Manufacturing and Applications of Stainless Steels

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1. Introduction and Scope

Stainless steels represent quite an interesting material family, both from a scientific and commercial point of view, owing to their excellent qualities in terms of strength and ductility, combined with corrosion resistance. Thanks to such properties, stainless steels have been indispensable for technological progress during the last century and their annual consumption has increased faster than other materials. They find application in all fields requiring materials with good corrosion resistance, together with the ability to be worked into complex geometries. Despite their diffusion as a consolidated material, many research fields are active regarding the possibility of increasing stainless steel's mechanical properties and corrosion resistance by grain refinement or alloying by interstitial elements. At the same time, innovations are coming from the manufacturing process of the stainless steel family of materials, including the possibility to manufacture them from metal powder for 3D printing. The scope of this Special Issue embraces interdisciplinary work covering physical metallurgy and processes, reporting about experimental and theoretical progress concerning microstructural evolution during processing, microstructure–properties relationships and various applications, including automotive, energy and structural.

2. Contributions

The book collects manuscripts from academic and industrial researchers with stimulating new ideas and original results. It consists of four review and ten research papers. The review papers focus on the state of the art and perspectives in repairing and reinforcing historic timber structures by stainless steels [1], on duplex and super-duplex stainless steel microstructures and the evolution of their properties by surface modification processes [2], on the process and properties of reversion-heated austenitic stainless steels [3] and on the 3D printing of stainless steels by the laser powder bed fusion technique [4]. A group of research papers deal with physical metallurgy and advancedcharacterization techniques [5], others with process aspects [6–8] or property application items related to stainless steels [9–14]. The paper by Fava et al. [5] presents and discusses the results of mechanical spectroscopy tests carried out on Cr martensitic steel. The study regards the following topics: (i) embrittlement induced by Cr segregation; (ii) the interaction of hydrogen with C–Cr associates; (iii) the nucleation of Cr carbides. This technique permitted the authors to characterize the specific role played by point defects in the investigated phenomena. Due et al. [6] investigate non-metallic inclusions in 316L stainless steel bars with and without Ca treatments. The inclusions are extracted using electrolytic extraction. After that, the characteristics of the inclusions, such as morphology, size, number, and composition, are investigated by using a scanning electron microscope in combination with energy-dispersive X-ray spectroscopy. Chen et al. [7] report the formation and characteristics of non-metallic inclusions in 304L stainless steel during the vacuum oxygen decarburization refining process, using industrial experiments and thermodynamic calculations. The compositional characteristics indicated that two types of inclusions with different sizes (from 1 to 30 μm) existed in 304L stainless steel during the refining process, i.e., $CaO–SiO_2–Al_2O_3–MgO$ external inclusions, and $CaO–SiO_2–Al_2O_3–MgO–MnO$ endogenous inclusions. Luu et al. [8] analyze the post-annealing mechanical behavior of 316L austenitic stainless steel (SUS316L) after electrically assisted annealing with a single pulse of electric current and evaluated the feasibility of a two-stage forming process of the selected SUS316L with rapid electrical assisted annealing. Peng et al. [9] report an experimental data assessment and fatigue design recommendation for stainless steel welded joints. Juuti et al. [10] present a new family of ferritic stainless steels for service temperatures up to 1050 °C, utilizing intermetallic phase transformation. Cianetti et al. [11] report a novel method for the evaluation of the surface fatigue strength of a stainless steel component. The proposed approach is a hybrid method, numerical–theoretical, which allows us to estimate the surface fatigue strength in a very short time without having to resort to finite element models that often are so complex that they starkly contrast industrial purposes. Prosviryakov et al. [12] present a novel corrosion-resistant steel with a high boron content. The positive influence of Zr addition on the microstructure and mechanical properties after hot deformation is shown. The Zr-alloyed steel demonstrates hot deformation without fracturing in the temperature range of 1273–1423 K, and in the strain rate range of 0.1–10 s^{-1}, despite the high volume of brittle borides. Gennari et al. [13] present a paper about the microstructural and corrosion properties of cold-rolled laser-welded UNS S32750 duplex stainless steel. Zhang et al. [14] report the temperature dependence of phase transformation kinetics during tempering in 13Cr super-martensitic stainless steel.

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

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