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Editorial

Advances in Design by Metallic Materials: Synthesis, Characterization, Simulation and Applications

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1. Introduction and Scope

Metals have exerted a significant influence throughout the history of mankind, so much so that the different periods of development have often been marked with the name of some material: bronze age and iron age. And all these centuries are studded with continuous discoveries and improvements that have involved materials. However, perhaps in a fairly recent period something has changed in the relationship between Man and Metals: even if until today the growth of humanity remains substantially based on the full exploitation of metals, their convenience compared to other emerging families of unconventional materials is increasingly questioned.

In particular, the central argument for this collection was chosen considering that very recently, a great deal of attention has been paid by researchers and technologists to trying to eliminate metal materials in the design of products and processes in favor of plastics and reinforced composites. After a few years, it is possible to state that metal materials are even more present in our lives and this especially is thanks to their ability to evolve. This Special Issue is focused on that and on the recent evolution of metals and alloys with the scope of presenting the state-of-the-art of solutions where metallic materials have become established, without a doubt, as a successful design solution thanks to their unique properties. The Special Issue also intends to outline the fundamental development trends in the field, together with the most recent advances in the use of the metallic materials.

2. Contributions

The collection includes papers regarding the most multifaced aspects of metals as synthesis [1–3], treatments [2–4], experimental characterization [4–7], material models [7–9] and engineering applications [10–12] providing a clear cross-section of the wide variety of topics and research arguments under investigation in the scientific community now.

It is the case of [1], for instance, where the authors propose a way for predicting the effects of changes in metal process parameters in terms of metal materials properties. The focus was addressed to a conventional cast iron foundry, with the aim of monitoring the process phases, but it also permitted to investigate a rather uncommon cast iron (i.e., compacted) in respect to others (i.e., spheroidal). With such a scope, standard mechanical experiments (i.e., tensile tests) were combined with an advanced approach based on pattern recognition and machine learning able to find physical recurrencies where a human eye cannot discover anything. Similar artificial intelligence tools, based on artificial neural networks, were also adopted in other papers such as [7] on the tensile behavior of an austenitic stainless steel or [5] on the determination of hardness and other surface properties.

Regarding metal processing, in [2] the authors investigated the process of hot forging and how its changes can influence the metal microstructures in the case of a carbon continuous cooling bainitic steel. Other unconventional processes and treatments are proposed, too, as, for instance, in [4] where the protective effect of tungsten carbide provided by HVOF coating on martensitic stainless-steel with respect to jet slurry erosion is discussed. This kind of erosion is rather uncommon in terms of present contributions to the state of

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the art, while it is quite frequent in practical applications (such as marine engineering, oil and gas applications and so on). However, surface hardening and wear continues to represent a relevant aspect to take care on in the use of metals, as demonstrated in [6] where metal matrix composites are experimentally investigated or in [8] where numerical models are developed in a way that predicts the final effect of hardening treatments. Numerical models, sometimes powered by finite elements, are also present in other contributions with the scope to predict plasticity [9] or failures [10] or, even, to support design actions with the scope to optimize the use of metal structures [11]. Finally, the last paper in the list [12] is maybe able to provide a synthesis in the proposed concept, regarding the opportunity of metallic materials, often considered as belonging to a quite old past, in an epoch where a large assortment of new materials is emerging, as in the case of polymer composites. This paper, not even doing it on purpose, deals with an intrinsic connection that our near future could bring out, merging two worlds only apparently strangers, when it proposes to use composite patches to repair metal bridges in order to extend their life for the benefit of society, not replace them.

3. Conclusions and Outlook

The realization of a Special Issue dealing with metallic materials represents quite a complex task for anyone, whatever the special topics it is focused on. This collection, concerning the use of metallic materials in advanced applications, is certainly no exception. This is the reason why there is no claim to completeness here, but only the desire to attract relevant articles coming from new and promising fields of investigation. In this, a proper result was achieved for sure.

Topics includes a large assortment of metals and alloys, such as steel, cast iron, aluminum, copper and metal matrix composites, together with their advanced use. In terms of processes the collection includes traditional processes such as casting, deformation or material removal, but special attention is also addressed to the most recent processes, such as additive manufacturing, metal deposition and so on. Contributions were selected with the scope to represent an element of novelty in the world of metallic materials as well as in the advanced characterization and use of metals for effective design solutions.

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

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