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Editorial

Special Issue on "Mechanical Behaviour of Aluminium Alloys"

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1. Introduction and Scope

Aluminium alloys are the most common type of non-ferrous material utilised for a wide range of engineering applications, namely in the automotive, aerospace, and structural industries, among others. Widespread use of these alloys in the modern world is due to a unique blend of their material properties, combining lightness, excellent strength, corrosion resistance, toughness, electrical and thermal conductivity, recyclability, and manufacturability. The last but not least important is the relatively low cost of aluminium extrusion, making aluminium alloys very attractive for applications in different key sectors of the world's economy.

Despite this great interest, extensive previous research, and knowledge accumulated in the past, recent advances in production and processing technologies combined with the development of new and more ingenious and competitive products require a profound understanding of the physical and mechanical behaviour, specifically in terms of modelling and predictions of fracture and fatigue, of aluminium alloy components. The current special issue aims to gather scientific contributions from authors working in different scientific areas, including on the improvement and modelling of mechanical properties, alloying design and manufacturing techniques, characterization of microstructure and chemical composition, as well as various advanced applications.

2. Contributions

2.1. Fabrication and Processing

Modern automotive and aerospace industries are facing new technological, economic, and environmental challenges. The development of more efficient and eco-friendly manufacturing processes is a crucial issue for commercial success in the current, highly competitive environment. This challenge has been previously explored by several authors. For example, Fracchia et al. [1] focused on the production of bi-metal engine pistons by sequential gravity-casting using both EN-AC 48000 and EN-AC 42100 aluminium alloys, and Zhao et al. [2] investigated the stability of single-layer combined lattice shells used as load-bearing structures in aerospace applications.

The mould industry has, for many years, resisted utilisation of aluminium. However, the present situation is quite different, which can be explained by the intrinsic advantages of aluminium as a moulding metal, such as low cost and faster production, to mention just a few. For example, aluminium–magnesium alloys are commonly used as moulds for the food industry. The paper written by Rodriguez-Alabanda et al. [3] proposed a novel method for the direct manufacture of non-stick moulds through a single-point incremental formation process, and studied the influence of the technological parameters on the dimensional precision of the moulds.

2.2. Characterisation and Modelling

The extremely complex relationship between the alloy design, microstructure, and mechanical properties is another area of intense research over the last few years. Below are several characteristic examples. Staab et al. [4] studied the stability of Cu-precipitates in Al–Cu alloys via the density-functional approach implemented through projected–augmented waves and plane wave expansions; the paper written by Li et al. [5] presented outcomes of a study on the effect of T6 heat treatments on tribological properties of Al–Si alloys reinforced with SiCp and processed by the electromagnetic stirring method; the paper written by Dumitraschkewitz et al. [6] provided an interesting insight into the impact of ternary-alloying elements on stacking fault energies intermetallic TiAl compounds using ab initio techniques; and finally, the paper written by Gómez et al. [7] suggested alternative methods to assess the dendrite coherency-point characteristics in $AlSi_{10}Mg$ alloys on the basis of higher-order derivatives of cooling rates and on the basis of third solid-fraction derivative curves.

Ferreira et al. [8] considered the effect of shot-peening and the stress ratio on fatigue crack propagation in aeronautical components made by the 7475-T7351 aluminum alloy, and Olvera et al. [9] analysed the stability of peripheral milling in thin-walled parts made of 7075-T6 aluminium alloys based on an enhanced multistage homotopy perturbation method.

2.3. Weldability

The weldability of aluminium alloys still represents a classic topic of research, as it did for many decades. Despite the progress made over the last few decades, many problems remain unsolved. For example, Zhang et al. [10] compared the effect of welding direction, namely vertical and inclined configurations, on the weld profile and grain morphology obtained using double pulsed-gas metal arc welding processes.

2.4. Advanced Applications

The current special issue includes a topic on high value-added products for biomedical and other demanding applications. The introduction and certification of such products is a strategic aspect in this ambit. This can be exemplified by a work by Hun et al. [11] who develop a new technique for the mass production of tubular anodic aluminium oxide films from 6061 aluminium alloy tubes, which can be applied in filtering, dialysis, and gas-diffuser processes.

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