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Editorial

Light Alloys and Their Applications

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1. Introduction and Scope

Light alloys usually refer to alloys that are based on light metals such as aluminum, magnesium, titanium, etc., which have particularly important applications in aerospace and automobile industries. Light alloys are the most popular choice for use in modern aerospace equipment, as they can overcome the limitation of the bearing capacity of body structures, and the ability to manufacture high-performance light alloys into large integral structural parts enables aerospace equipment to have high functional levels and be competitive. Aluminum alloys are generally used as lightweight materials in NEVs. Studies have shown that energy consumption can be reduced by 6–8% if the weight of a whole vehicle is reduced by 10%. The magnesium–lithium alloy, as the metal structure material with the lowest density at present, has also been applied in the space field by the United States, China, and other countries. Although light alloys have been successfully applied in various fields, some shortcomings remain to be overcome. Research in the field of light alloys is still in progress.

The original articles published in this Special Issue cover the areas of basic research, thermomechanical calculations, the design of novel alloys, and the mechanical and fatigue properties of titanium alloys, aluminum alloys and magnesium alloys.

2. Contributions

Eleven papers of high scientific quality have been published in the present Special Issue of Metals, covering different research areas regarding titanium alloys, aluminum alloys and magnesium alloys. The contents of the published manuscripts are briefly described below.

Five papers consider pure titanium, titanium alloys and titanium–aluminum alloys, including four research papers and one review paper. The microstructure and mechanical behaviors of commercially pure grade-4 (Gr.4) titanium strips under different deformation conditions were investigated by Zhu et al. [1]. The results showed that cold deformation can significantly improve the strength and hardness of a commercially pure titanium Gr.4 strip, which has significant work hardening characteristics. With the increase in deformation level, the grain was stretched into a fibrous shape along the longitudinal direction, while the strength and hardness increased and the plasticity decreases. Moreover, there was a significant linear relationship between the tensile strength and hardness. A thermodynamic evaluation of Ti-Al-Fe-V quaternary system was carried out and a self-consistent thermodynamic database was established by Feng et al. [2]. Based on this, three different types of titanium alloys were designed. Wu et al. [3] studied the microstructure evolution and the irradiation sensitivity of different phases of a high-Nb-containing TiAl alloy under He ion implantation at room and high temperature. It was found that helium bubbles prefer to nucleate at defects including lattice vacancies, dislocations and lamellar boundaries. The irradiation sensitivity of different phases was considered to be related to their crystal structures. Duan et al. [4] prepared Ti-46Al-8Nb alloy ingots beyond the laboratory scale based on a $BaZrO_3$ refractory crucible. The results showed that the tensile

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strength of the longitudinally cut sample was up to 700 MPa, and the elongation was 1.1%. Although titanium has excellent all-round performance, its high production cost limits its widespread use. In order to reduce the production cost of titanium, researchers have developed many new processes. Feng et al. [5] reviewed the current status of the development of various new processes and analyzed the advantages and disadvantages of each process. The authors believe that the thermal reduction method is basically an improvement of the Kroll process and that electrolysis, represented by the FCC process and the OS process, is the most promising method to replace the Kroll process.

Four papers investigated the fatigue properties, corrosion behavior and their applications of aluminum alloys. Shi et al. [6] studied the effects of actual marine atmospheric pre-corrosion and pre-fatigue on the fatigue properties of the 7085 aluminum alloy. The experimental results showed that marine atmospheric pre-corrosion significantly reduces the fatigue life of the 7085 aluminum alloy, while selective pre-fatigue can improve the total fatigue life of pre-corroded specimens. Wu et al. [7] demonstrated that CEC (cyclic extrusion compression) is an efficient method to improve the mechanical properties of materials due to substantial microstructural changes along with the enhancement of electrochemical behavior because of the presence of small-sized and shallow pits. Wang et al. [8] provided a theoretical basis for the application of the 2A12 aluminum alloy in spacecrafts by establishing a finite element simulation model for the nosing of a non-disengagement fastening device's 2A12 aluminum alloy spacing shim. The Be-Al alloy is the preferred material for use in lightweight aerospace products. Li et al. [9] firstly introduced the characteristics of the Be-Al alloy and then presented details of the mechanism of the effect of added elements on the casting process, mechanical properties and tissue evolution. Finally, the heat treatment technology and the repair of defects via electron beam welding were also demonstrated.

The last two papers presented in this Special Issue are related to the study of magnesium alloys and the Inconel 625 alloy. Yin et al. [10] clarified the controversy surrounding phase equilibrium in the Mg-rich corner of the Mg-Zn-Sm system by determining the phase constitution, composition and crystal structure of this alloy. Subsequently, a self-consistent thermodynamic database was obtained based on experimental data, and its establishment provided a basis for the further development of the Mg-Zn-Sm alloy. Wang et al. [11] prepared Inconel 625 alloy thin-walled structures using the gas tungsten arc welding (GTAW) hot-wire arc additive manufacturing process and studied the microstructure and mechanical properties of the Inconel 625 samples extracted from different orientations and locations of the thin-wall structure. The results showed that the additively manufactured Inconel 625 component, made via hot-wire GTAW, was of good quality. Its microstructure consisted of dendrites, equiaxial crystals and cellular crystals. The average hardness from the bottom to the top was similar, indicating that the thin wall had good consistency.

3. Conclusions and Outlook

The contributions included in the present Special Issue of Metals cover a wide range of research regarding light alloys, representing a well-balanced combination of theoretical and practical approaches. It is hoped that this Special Issue will be of interest to a wide range of readers and promote further research into light alloys and their applications.

As Guest Editor, I am very pleased to report the success of this Special Issue and hope that the papers will be useful to researchers researching areas related to light alloys. I am sincerely grateful to the authors for their contributions and the reviewers for their significant efforts in providing high-quality publications. I give sincere thanks to the editors and editorial assistants of *Metals* for their continuous support during the preparation of this volume. In particular, I would like to warmly acknowledge Ms. Sammi Meng for her valuable assistance.

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