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Editorial

Casting and Forming of Light Alloys

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1. Introduction and Scope

With the rapid development of aviation, aerospace, navigation, automotive, electronics and other fields, the demand for light alloys components is increasing, and the performance requirements are becoming higher and higher, especially for large complex light alloys components. Therefore, high performance light alloys will have a great application potential in the future. The casting and forming of light alloys is an important step to obtain large and complex light alloy components with a high performance. Together with the compositions of light alloys, they determine the formability, defects, microstructure and mechanical properties of light alloys.

This Special Issue aims to present the latest developments in the casting and forming of light alloys. The preparation process and performance enhancement of Al, Mg or their composite materials are mainly studied. Particular attention has been paid to the relationship between process conditions, microstructural features and mechanical properties.

2. Contributions

This Special Issue contains a total of 11 articles covering the topic of the casting and forming of light alloys such as Al and Mg. Among them, six papers are about Al alloys, four papers are about light metal composite materials, and one paper is about Mg alloys.

Huang et al. [1] compared the microstructure of a AlSn20Cu wear-resistant alloy prepared using semi-continuous casting, semi-solid die casting and spray forming. The results showed that the tin phase particles of the alloy prepared using semi-continuous casting had a prolate particle shape, the tin phase of the alloy prepared using semi-solid die casting was nearly spherical and strip shaped, and the tin phase in the alloy prepared using spray forming and hot extrusion was nearly equilateral shaped. Among the three preparation methods, the semi-solid die casting had the shortest process time, and the spray molding process could obtain a finer and more uniform tin phase structure.

Shlyaptseva et al. [2] developed a new modifier with complex effects on the structure of Al-Si alloys. The modifier was composed of TiO_2, BaF_2 and KF. Under the role of the composite modifier, the α-Al dendrites, Al-Si eutectic and primary Si were all refined to different degrees. The SDAS and the average area of eutectic silicon in aluminum alloys with different Si contents were all reduced. The composite modifier could increase the strength of the hypoeutectic and eutectic silumins by 10–32% and the plasticity by 24–54%.

Zheng et al. [3] studied the effect of the Zn/Mg ratio on the hot deformation behavior of an AA7003 alloy. The optimum hot working temperature of the ternary alloy AA7703 was in the range of 653 K to 813 K, and the strain rate was lower than 0.3 S^{-1}. Materials with a low Zn/Mg ratio could cause problems with hot deformability. Alloys with higher ratios had better machinability. The Al_3Zr dispersoid in the alloy could effectively inhibit the recrystallization of the AA7003 alloy, and the Zn/Mg ratio could potentially affect the drag force of the dispersoids.

El-Sayed et al. [4] discussed the influence of casting process parameters on bifilm defects in aluminum alloy casting. The bifilm defects produced during the filling process of

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the aluminum alloy had adverse effects on the mechanical properties. Adding filters to the gating system and reducing the hydrogen content of the molten metal could minimize the possibility of bifilm defects and significantly increase the tensile strength and elongation of the casting.

Petrov et al. [5] reported the effect of rubidium on the solidification parameters, structure and operational characteristics of a eutectic Al-Si alloy. The rubidium was relatively distributed in the silicon phase, effectively refining the eutectic silicon and changing its morphology. Rubidium modification changed the solidification parameters of the alloy. The solidus temperature and eutectic solidification onset temperature were significantly lowered, leading to an expansion of the solidification range.

Chandra et al. [6] compared the mechanical properties and wear resistance of an Al-Si alloy prepared using squeeze casting and gravity casting. The results showed that compared with gravity die-casting, the Al-Si alloy prepared using high pressure squeeze casting was refined due to the increased cooling rate and the destruction of primary dendrites during solidification via extrusion pressure. The grains were refined and the dendrite arm spacing was reduced. The reduction in casting defects in high-pressure squeeze casting alloys resulted in a lower coefficient of friction and an improved alloy wear resistance.

Yuan et al. [7] studied the friction and wear properties of friction stir welding CiCp/ZL101 and Zl101 composites at different temperatures. The results showed that the sliding friction process at each temperature was relatively stable, and the average friction coefficient was stable at about 0.4. The wear forms at room temperature were mainly oxidative wear and abrasive wear. As the temperature increased, the main wear form became fatigue wear. When the temperature reached 200 °C, the characteristics of adhesive wear appeared. After 250 °C, the composites had high-temperature lubricating properties. The composite materials had good high-temperature friction and wear properties.

Zhang et al. [8] prepared porous 2024Al-Al_3Zr composites using in situ and spatial scaffolding methods, and studied the effects of Zr content and space scaffold (NaCl) content on the properties of the composites. Studies showed that with the increase in Zr content, the powder cohesion was enhanced and the defects were significantly reduced. The increase in Al_3Zr reduced the stress concentration and hindered the crack growth. However, too much Al_3Zr increased the brittleness and reduced the performance. The increase in space scaffold content led to a gradual decrease in the compressive properties and energy absorption performance of the material.

Feng et al. [9] studied the effects of roll speed, pouring sequence and solidification length on AZ91D/A5052 clad strips prepared using direct cladding from molten metals. The results showed that the rolling speed had an influence on the average thickness of the solidified layer. The thickness of solidified layer decreased with the increase in rolling speed. The high-melting-point A5052 alloy, when poured into the lower nozzle, could solve the remelting problem of the low-melting-point AZ91D. Extending the solidification length could reduce the generation of intermetallic compounds.

Guan et al. [10] studied the effect of vibration acceleration on the microstructure and properties of a composite-casted Mg-Al bimetal interface. With the increase in vibrational acceleration, the cooling rate of the bimetal increased, leading to reductions in the reaction duration to form the intermetallic compound and its thickness. And the Mg_2Si phase in the IMC's layer was refined and distributed more uniformly.

Sun et al. [11] reported the latest progress on the effect of Zr in the grain refinement of magnesium alloys. The Mg-Zr master alloy ensured a clean interface between the Zr particles and Mg solution, which was beneficial to the diffusion of Zr elements and improved the utilization rate of nucleation. It was an efficient way to introduce Zr elements. The mechanism of grain refinement using Zr was attributed to the heterogeneous nucleation and constitutional supercooling effect. Pretreatment of the Mg-Zr master alloy or treatment of the solution could improve the utilization rate of Zr and obtain a better refining effect.

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