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# A Special Editor's Issue on Magnesium Matrix Composites

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Magnesium (Mg) alloys offer distinct advantages as one of the lightest structural metals. Their remarkable weight advantages, being 35% lighter than aluminum alloy and a striking 78% lighter than steel, make them a focal point for research in automotive and aerospace applications. This emphasis stems from the overarching goal of reducing energy costs and enhancing overall performance [1, 2]. Despite these advantages, Mg alloys face challenges, including low strength, elastic modulus, poor wear resistance, and limited performance at elevated temperatures [3]. To overcome these limitations and unlock the full potential of Mg, researchers are actively exploring Mg-based composites. The development of Mg matrix composites (MMCs) is significant as these materials exhibit higher specific strength, specific modulus, and a lower thermal expansion coefficient compared to pure Mg alloy. These advantages make MMC a promising frontier in the development of lightweight structural materials, providing a potential solution to the shortcomings of magnesium alloys and paving the way for a new generation of high-performance materials.

Currently widely used reinforcements in MMCs mainly include ceramic particles, such as carbides (SiC, TiC), oxides ($Al_2O_3$, $TiO_2$), nitrides (AlN, TiN), etc. [4]. Graphene based reinforcements, including graphene nanoplate (GNP) [5, 6], graphene oxide (RGO) [7], graphene nanosheet (GNS) [8] etc., have also attracted many researches to develop MMCs. Besides, Mg-based bimetal plates exhibit combined advantages of two metals, which show optimized mechanical properties including strength, fatigue, and abrasive resistance, such as Mg/Al, Mg/Ti, etc. [9]. In addition to the bimetallic composites in the form of plates, it is also possible to add insoluble metal particles to Mg alloys to fabricate the metal-reinforced MMCs, such as Ti particles [10–14] etc.

The most challenging aspect in the development of Mg-based composites lies in the fabrication methods and the modification of the interface between Mg and reinforcements. Fabrication methods need to be precisely tailored to achieve a homogenous distribution of reinforcements within the Mg matrix, ensuring optimal structural integrity and performance. To date, many fabrication methods were used in the development of MMCs, such as powder metallurgy [1], in-situ fabrication [15], stir casting, ultrasound assisted stirring [10] etc. Additionally, addressing the interfacial interactions between Mg and reinforcements is crucial to enhance the coordinated plastic deformation. Overcoming these challenges requires innovative techniques and meticulous attention to unlock the full potential of Mg-based composites for various applications. For example, many researchers calculated the adhesion strength, interfacial stability, and electronic properties of Mg/reinforcements based on first-principle study to design strong interface [16]. Machine learning can also be applied to predict the tensile strength of particles reinforced MMCs, and additional trial-and-error experiment is accordingly avoided to effectively develop MMCs.

This issue features a selection of cutting-edge research in the areas of Mg-based composites reinforced with various reinforcements using novel fabrication methods. It comprises 16 contributions from many affiliations, including Chongqing University, Shanghai Jiao Tong University, University of Science and Technology Beijing, Dalian University of Technology, Beijing University of Technology, Qinghai University, The 38th Research Institute of China Electronics Technology Group Corporation, Chongqing University of Technology, Taiyuan University of Technology, Nanchang University, Chang'an University, North University of China. One review is included, highlighting the modification methods that could be explored to further develop the MMCs for various applications.

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