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Editorial: Recent Advances in Biodegradable Biomedical Magnesium Alloy

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Editorial on the Research Topic

Recent Advances in Biodegradable Biomedical Magnesium Alloy

Biomedical implants have been widely applied in clinical practice to replace severely damaged tissues and organs that are seriously missing in structure and function (Jacob et al., 2020). With the progress of science and technology and the improvement of living standards, patients have higher and higher requirements for implant performance, such as biodegradable absorption, better biocompatibility, mechanical matching and so on. Based on this, biodegradable magnesium (Mg) and its alloy implants emerge as promising candidates such as Mg alloy vascular stent, Mg bone nail, etc. However, the controllable degradation and the adaptation to the lesion tissue as well as the limited biocompatibility are the bottleneck problems in the development and application of biomedical Mg alloys. Therefore, it is very important and meaningful to integrate multi-disciplinary background, such as materials, biology, mechanics, medicine, etc., to provide support for the development of biodegradable Mg alloy implants.

This research topic aimed to explore the recent advances in this area with a focus on the systematic research and innovative discovery of Mg and its alloy design, process, evaluation, surface modification and other aspects of Mg alloy implants. We have collected two review articles and two original research articles, which highlight several emerging trends of magnesium and its alloys for biomedical implants.

Rahim et al. reviewed the surface modification of research progress of magnesium alloy in the orthopedic application. The methods of regulating the degradation rate and biocompatibility of magnesium alloys by surface modification are reviewed, mainly including chemical conversion coatings (such as electrochemical conversion, acid treatment, alkali treatment and hydrothermal treatment), physical deposition coatings (such as dipping coating, spin coating, sol-gel coating, electrospinning, physical vapor deposition, chemical vapor deposition and thermal spraying.), surface microstructure modification (such as pulsed electron beam modification, surface laser melting, surface mechanical attrition, shot peening, laser shock peening, etc.). The author also emphasizes that the article mainly discusses the research progress of surface modification of degradable magnesium alloys. Other bioactive coatings and surface modification technologies can be further used for surface modification of magnesium alloys to improve biocompatibility and antibacterial properties. The author believes that the combination of mechanical treatment and surface modification may be an ideal design method for orthopedic application.

In addition to traditional orthopedic implants, magnesium alloy plays an important role in the reconstruction of the anterior cruciate ligament, but how to reduce the risk of translation from animal experiments to the clinic is still a challenge. Therefore, Shang et al. systematically reviewed the actual efficiency of the magnesium alloy in the reconstruction of anterior cruciate ligament. The authors mainly

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collected articles published in seven major academic databases (including PubMed, Web of Science, CNKI, et al.) in July of 2021 and conducted a detailed meta-analysis. The results showed that the mechanical properties of the femoral tendon graft tibia complex fixed with the magnesium alloy were comparable to those of titanium alloy, moreover, magnesium alloy can promote bone formation as compared to titanium alloy. However, the degradation rate of the magnesium alloy needs to be better controlled to meet the integration rate of bone-tendon, and whether the biological binding of bone-tendon after degradation can meet the requirements of exercise load still needs to be further explored. At the same time, the author also points out that in order to reduce the risk of the translation from animal experiments to the clinic, it is necessary to further carry out standard research for experimental design, results analysis and measurement.

As a biodegradable metal, magnesium alloy often forms galvanic battery with other metal materials after the implantation in human body, which could accelerate the *in vivo* corrosion of the magnesium alloy. Therefore, Peng et al. studied the galvanic corrosion behaviors of the magnesium alloy in simulated body fluid after forming galvanic battery with 316L, TA2, and AZ91. The results show that three metals can accelerate the corrosion rate of pure magnesium to varying degrees after the formation of galvanic corrosion, so as to reduce the tensile strength and increase the mechanical failure. The results of this study have an important guiding significance for the corrosion problems faced by the different metals implanted at the same time.

The construction of bioactive layer on the magnesium alloy surface represents an effective method to improve the biocompatibility. In the article by Feng et al. strontium-substituted hydroxyapatite was firstly prepared on the magnesium alloy surface by electrodeposition technique, followed by silane treatment. Finally, the polyelectrolyte multilayers of chitosan (CS) and sodium hyaluronate (HA) were constructed on the surface by electrostatic layer by layer self-assembly. The results showed that the modified magnesium alloy had excellent corrosion resistance, can promote the adhesion and proliferation of mesenchymal stem cells, and can significantly enhance the antibacterial activities. Therefore, this method can provide a novel and facile method to modify the magnesium alloy surface to simultaneously enhance the corrosion resistance, biocompatibility and antibacterial activities.

In summary, this Research Topic covers recent advances in the magnesium-based biomaterials for biomedical implants, providing new strategies to improve the corrosion resistance and biocompatibility so as to be used for biomedical implants. The editors envision that the Research Topic "*Recent Advances in Biodegradable Biomedical Magnesium Alloy*" will contribute to the research and development in the field of magnesium-based biomaterial for biomedical implants, inspiring future work leading to the expansion of the biomedical applications of magnesium and its alloys.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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