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Magnesium's Impact as a Biomaterial in Biodegradation

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Abstract

Printing magnesium in an inert atmosphere while ensuring safe material handling will require specialized equipment. Therefore, the additive manufacturing of disposable magnesium-based implants poses certain challenges because of inherent properties of magnesium mixes, such as a higher vapour pressure and a stronger inclination to oxidize. The high rate of corrosion of magnesium-based implants leads to cytotoxicity, hydrogen evolution, alkalization, unintentional degradation, and structural failure.

Keywords: Polymers; Biomaterials; Biodegradation

Introduction

Several techniques, including the creation of a magnesium alloy and surface property modifications, are used to customize the rate of degradation because the goal is for biodegradable magnesium-based implants to exhibit controlled degradation and meet application-specific requirements. The biodegradation mechanism, as well as its regulating elements and remediation strategies.

Methodology

Biomaterials frequently suffer from fatigue, erosive wear, and corrosion. The properties of the biomaterial are necessary for osseointegration to be accepted. Biocompatibility and mechanical endurance are the two most important factors that are considered for any type of engraft, whether it be temporary or permanent. Incorporating two or more implants requires strong corrosion resistance. The rate of degradation is also important for biodegradable materials. The implant material needs to be biologically stable when it comes into contact with blood, soft tissues, and extracellular fluid, in contrast to its mechanical properties. The implant medium needs to have characteristics like high corrosion resistance, wear resistance, and biocompatibility with human bone in order to encourage osseointegration. The majority of biomaterials are composed of polymers.

Polymers, ceramics, metals, and their composites make up the majority of biomaterials. Currently, common materials are used, such as titanium and stainless steel that contains cobalt and chromium. Metallic materials play an important role as a biomaterial by helping to replace or heal damaged or diseased bone tissue, in contrast to polymer and ceramic materials. Their high fracture toughness and mechanical strength are the reasons for this [1-3]. Metallic biomaterials have been the most well-known biomaterials used in the treatment of musculoskeletal disorders and coronary heart disease. Its mechanical and biological properties, which are generally favorable, are primarily responsible for this. In this sense, the materials most frequently utilized in biomedical applications are titanium (Ti) and its alloys, cobalt-chromium alloys, stainless steels.

With the exception of magnesium, the majority of these bio-metallic compounds have a high elastic elasticity that leads to stress shielding and a tendency to release ions that could be harmful to the host tissues and system [4-6].

Biomaterials made of magnesium have an appropriate weight and density. Nevertheless, pure magnesium undergoes uncontrollable biocorrosion when it comes into contact with biological fluids. Magnesium implants deteriorate physically, causing an increase in pH, the production of hydrogen, and premature implant failure. This might lead to an imbalance between the mechanical support required by newly formed tissue and bone regeneration. Thus, the most pressing need in material science is the development of novel magnesium-based biomaterials that could be utilized as dental implants [7-9].

Long-lasting titanium and cobalt implants carry a lower risk of metal sensitivities because the biodegradable implant will eventually break down and be eliminated from the body. Magnesium rusts easily in biological fluids despite its exceptional mechanical and biological properties. Over time, this may lead to a large amount of Mg2+ ions being released, which could quickly weaken the implanted material [10].

A study on magnesium material engrafts for bone repairs demonstrates superior biocompatibility and restorability. However, if large amounts of hydrogen gas are released, it could be harmful. Hydrogen evolution usually has no significant effect on small-scale engraft, such as stents, but it could be problematic.

Conclusion

Gas gaps near mg engraft in human tissue can be caused by hydrogen bubbles because of hydrogen accumulation and a lack of transport mechanisms. One can lower the risk of osteosynthesis by puncturing hydrogen bubbles. Therefore, it is preferable to stop hydrogen gas bubbles from forming.

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