

Bioresorbable Mg implants modified by nanostructured merwinite/PEO coating for hard tissue repairs

Metallic biomaterials for example stainless steel, titanium, and cobalt - based alloys are using as permanent bone implant materials for orthopedic applications. However, they have some problems : 1) the difference between the mechanical properties of that metals with that of the bone tissue can cause bone loss and implantation failure; 2) the release of toxic element such as Ni in stainless steel (316 L), can result in the metal allergy and skin disease. Recently, magnesium (Mg) alloys have been recommended as biodegradable bone implant materials because of the suitable biocompatibility and mechanical properties. Moreover, due to the biodegradability of Mg alloys, second surgery for implant removal might be avoided. Although, Mg has attractive properties as an orthopedic implant material, its rapid corrosion may cause the loss of mechanical stability of the implant during the bone healing period. Also, the hydrogen gas evolution during the corrosion process can delay the tissue repair. For this reason, the fast corrosion rate of Mg implants has limited their clinical applications.

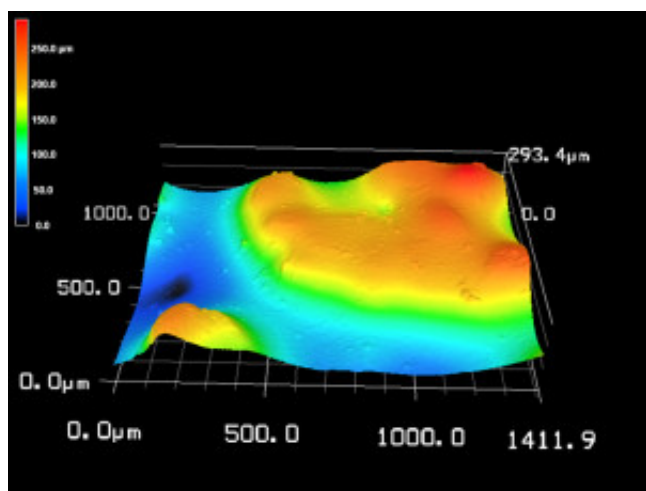


Fig. 1. Laser scanning microscopy image from merwinite/PEO coated AZ91 Mg implant.

Among the common techniques for increasing the corrosion resistance of a metal, surface coating is more effective. Selection of suitable coating material is important for improvement the biological behavior. As a bioactive ceramic, Merwinite with the chemical formula of $\text{Ca}_3\text{MgSi}_2\text{O}_8$ has presented the *in vitro* biocompatibility for bone defects. Thus, with the aim of overcoming fast corrosion of Mg alloys, we have recently achieved a nanostructured merwinite ($\text{Ca}_3\text{MgSi}_2\text{O}_8$) coating on AZ91 Mg alloy through the coupling of electrophoretic deposition (EPD) & plasma electrolytic oxidation (PEO) techniques (Fig. 1). In this work, we tried to focus on the biocompatibility of the uncoated and coated implants by *in vivo* animal examinations. For this

purpose, the rod implants, including the uncoated and merwinite/PEO coated implants, were implanted into the greater trochanter of rabbits.

With more details, holes of 3 mm diameter were made in the greater trochanter of the rabbits with a hand driller, and the rod samples of 3 mm diameter and 6 mm length were implanted in the holes. The rabbits were sacrificed after 8 weeks and the samples with bone were taken out. The results of the *in vivo* animal test confirmed an improvement in biodegradability and biocompatibility for merwinite/PEO coated implants compared to uncoated one. In summary, proper surface coating of Mg implants such as silicate bioactive ceramics may improve their biological characteristics to making them suitable and applicable for future clinical applications.

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