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（博士課程）
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論 文 要 旨
THESIS SUMMARY

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要旨（英文 800 語程度）
Thesis Summary (approx.800 English Words)

In the recent years, the demand for bone implantation in the world increases significantly. Therfore, the research on fabrication and development of implant materials becomes very essential. Mg matrix composite is one of the very promising candidates for temporary implant applications due to their high specific strength, low Young's modulus equivalent to that of bone, and good biocompatibility. Especially, Mg matrix composites are biodegradable and bioabsorbable materials. Hence, the secondary surgery to remove the implant after healing is not required. However, the fast biodegradation *in vivo* of Mg matrix composites leading to a low mechanical integrity limits their biomedical applications. This project aims to fabricate new Mg matrix *in situ* composites with good mechanical properties and corrosion resistance for temporary implant applications. Spark plasma sintering method was employed to fabricate Mg matrix *in situ* composites from homogeneously mixed Mg – 5, 10, 20 wt% ZnO powders respectively.

The result demonstrated that *in situ* reactions occurred during sintering process producing MgO, Zn and Mg–Zn intermetallic compounds. The formation of *in situ* products strongly contributed to the enhancement of the strength and the ductility of the fabricated composites compared with pure Mg. Specifically, the highest strength at 380 MPa was observed in the Mg-20 wt-% ZnO composite, and the highest failure strain at 12.9% was achieved in the Mg-5 wt-% composite compared with the 156 MPa strength and the 10.2% failure strain of pure Mg. In addition, the strengths of as-produced composites are as double as that of cortical bones.

As for corrosion property aspect, *in vitro* corrosion properties of fabricated Mg matrix *in situc* composites were evaluated by immersion and by electrochemical tests using Hanks'

solution. The results showed that the formation of *in situ* products improved significantly the corrosion resistance of the fabricated composites compared with pure Mg; Mg-10 wt % ZnO composites especially exhibited the lowest corrosion rate. In addition, an energy-dispersive X-ray (EDX) analysis showed that calcium phosphate formed as a corrosion product on the surface of Mg-10 wt % ZnO composites, while Mg(OH)2 appeared as a corrosion product on the surface of Mg-20 wt % ZnO composite.

In order to further improve corrosion resistance of the as fabricated composites, HAp coating was carried out successfully on as fabricated composites. The results suggested that HAp grows homogeneously on the surfaces of pure sintered Mg as well as fabricated composites. HAp layer on the surface of composites is thicker than that on pure Mg. The structure of HAp layer consisting of two sub-layer: inner dense subl-layer and outer plate like sub-layer. HAp coating improves significantly the corrosion resistance of the as fabricated composites, especialy HAp coated Mg-10ZnO-2h30+10min. Corrosion product deposited on the surface of HAp coated Mg-10ZnO-10min after 14 days of immersion contains some kinds of calcium phosphate compound, while HAp is main component on the surface of immersed HAp coated Mg-10ZnO-2h30+10min.

In vitro biocompatibility of HAp coated and uncoated Mg matrix *in situ* composites was investigated by cell culture tests for 1, 2, and 3 days respectively. The results indicated corrosion resistance plays an important role in the cell viability on the surface of uncoated composites. High hydrogen gas released rate results in death of cell on the surface of uncoated composites. HAp coating improves significantly the corrosion resistance of the composites, resulting in improving significantly cell viability on the surface of coated composites. The improvement of cell viability on the surface of the composites might be originated from the preventing of high hydrogen gas released rate at the beginning of immersion. This is very important role of HAp coating on the cell viability on the composite surface. The results suggest that the as fabricated Mg matrix *in situ* composites are very potential candidates for temporary implant applications.