論 文 内 容 の 要旨

Abstract of Dissertation

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Study on Enhancement of Antibacterial Property by Fluorescent Complex of Hydroxyapatite with Amino Acids Fabricated by Cold Isostatic Pressing

（冷間等方圧加圧法で合成した水酸アパタイト-アミノ酸錯体による抗菌性増強に関する研究）

Titanium alloys is widely used as the implant materials in medical, orthopedic surgery and dental fields. Its high specific mechanical strength, corrosive resistance and superior biocompatibility are advantage comparing to other metallic implant materials. In order to improve the biocompatibility, Hydroxyapaptite (HAp) is introduced as a coating because of its advantage in osteo-conductivity. It improves cell adhesion strength and increases cell proliferation. However, after long period of used, infections become serious problem that causes revision of surgery sequentially. In order to suppress bacterial infection problem, our study aims at to develop the fluorescent complex of composited photocatalyst gray titania/HAp coating with amino acid.

Firstly, we investigated the fabrication of fluorescent complex HAp – amino acid coating based on the mechanical compressive force of cold isostatic pressing (CIP) effected on the orientation of ligands. This part of study is focusing on revealing the effects of pressures during CIP process on microstructure of HAp fluorescent complexes and its optical property. It has been reported in previous study from our research group that microstructural-dependent property of fluorescent complex improves antibacterial property of photocatalyst coating. However, behind the mechanism of changing in fluorescent property of highly-compressed HAp complex has not been investigated and clarified.

Secondly, mechanism of enhancement of antibacterial properties of composited gray titania and plasma - sprayed HAp – amino acid fluorescent complex under visible light irradiation was

investigated and discussed. According to CIP fabrication, HAp – amino acid fluorescent complexes were successfully fabricated by three types of amino acid ligand; Phenylalanine (Phe), Tryptophan (Try) and Tyrosine (Tyr) respectively. Biocompatible test was conducted by cytotoxicity assay of murine osteoblast like cells. The bacterial testing was conducted against to the Escherichia coli (E.coli) bacterial. Antibacterial assays revealed that three type of HAp – amino acid fluorescent complexes and irradiation with three types of light emitting diodes; blue, green and red respectively are significantly decreasing number of colony forming units. The mechanism of phenomenon results were explained by Kelvin force microscopy (KFM) that measured surface potential simultaneous visible light irradiation. Comparing of surface potential between HAp and HAp – amino acid fluorescent complexes, it revealed that HAp – amino acid fluorescent complexes preserved the surface potential even after the visible light irradiation. On the other hand, surface potential of HAp coating were significantly decreased by light irradiation. The preservative effect on the HAp – amino acid fluorescent complexes maintained the bacterial adhesion as same as HAp performance. The consequence is antibacterial action of gray titania becomes superior.

Finally, our achievement demonstrated that the antibacterial performance is enhanced by the sensitive-photocatalyst fluorescent complexes of HAp – amino acid. The fabrication of fluorescent complexes HAp – amino acid is successfully made by CIP process. The antibacterial property is enhanced during visiblelight irradiation on the sensitive photocatalyst fluorescent complexes of HAp – amino acid because of its potential surface behaves similar to HAp itself during the irradiation. Cell seeding and proliferation were not interrupted and it is compatible for using as dental implants.