TI\textsubscript{2}O\textsubscript{2} DEPOSITION ON HYDROXYAPATITE SINGLE CRYSTAL UNDER A HYDROTHERMAL CONDITION

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Abstract TiO\textsubscript{2}—hydroxyapatite composites are noticed for its possibility of environmental applications, because HA adsorbs organic matters, and TiO\textsubscript{2} can decompose organic matters efficiently under irradiation. However, it has been unsolved whether bonding between TiO\textsubscript{2} and HA is good enough for practical use. This study reported a new knowledge on bonding between TiO\textsubscript{2} and HA by demonstrating selective deposition of TiO\textsubscript{2} on the $a$—face of the HA single crystal in hydrothermal condition.

INTRODUCTION

A combination of hydroxyapatite (HA) and TiO\textsubscript{2} can function as effective adsorbent for environmental and antibacterial applications, because HA adsorbs organic matters, and then TiO\textsubscript{2} can decompose organic matters under irradiation. Some TiO\textsubscript{2}—HA composites are noticed for its possibility of practical applications.\textsuperscript{1,2} However, present TiO\textsubscript{2}—HA composites provide no information about the bonding between HA and TiO\textsubscript{2}. Further, it has been unsolved whether bonding between TiO\textsubscript{2} and HA is good enough for practical use. In this study, selective TiO\textsubscript{2} deposition on specific crystal face of a HA single crystal under hydrothermal condition was observed.

EXPERIMENTAL

Crystallization of HA occurs at temperature range from 513 to 556 K in a pressure vessel using CaHPO\textsubscript{4} (DCP), ultra—pure water as starting materials.\textsuperscript{3} In this study, HA
single crystals were prepared in the same manner as mentioned above but supplementing Ti to the starting materials using Ti–bearing DCP. The Ti–bearing DCP was prepared by adding four–nine–grade calcium carbonate powder (Ube Materials Industries, Japan) into a 5 mol/l orthophosphoric acid solution (Wako, Japan) containing 0.035 mol/l Ti(III) up to saturation at room temperature. The Ti–bearing DCP powder (1 g) was hydrolyzed in ultra–pure water (60 cm³, electric resistance = 18.3 MΩ/cm) using a stainless steel pressure vessel with a Teflon inner vessel at 523 K for 2 weeks. The product was recovered after quenching, then washed by 5–minute ultrasonic washing. The product was examined by a scanning electron microscope (SEM), a x–ray diffraction, and an electron probe microanalysis (EPMA).

RESULTS AND DISCUSSION

A scanning electron microscope (SEM) image reveal that the products were hexagonal prismatic exhibiting an idiomorphic form of HA single crystal (Figure 1). A x–ray diffraction pattern of the product indicates that the product is well crystallized HA with a small proportion of TiO₂. Therefore, the product was considered to be a TiO₂–HA composite.

The SEM observation from the major axis of the product revealed a thin layer on the a–face of a HA single crystal (Figure 2). Further, the electron probe microanalysis (EPMA) indicated the presence of Ti on the thin layer (Figure 3). Therefore, we
conclude that the thin layer on the α-face of the HA single crystal is TiO₂. Bonding between the TiO₂ thin layer and the α-face of the HA single crystal was enough tough to survive 5-min ultrasonic washing.

HA single crystals without the TiO₂ thin layer were also found in the product. No distinct difference in size and shape was observed between the HA single crystal without the TiO₂ thin layer and that with the TiO₂ thin layer. This result implicates that formation of the TiO₂ thin layer has no effect on the growth of the HA single crystal in the hydrothermal solution. Therefore, it can be considered that the TiO₂ thin layer was deposited on the α-face of the HA single crystal by the quenching.

In summary, this study reported a new knowledge on bonding between TiO₂ and HA by demonstrating selective deposition of TiO₂ on the α-face of the HA single crystal in hydrothermal condition.

REFERENCES