TiO₂ DEPOSITION ON HYDROXYAPATITE SINGLE CRYSTAL UNDER A HYDROTHERMAL CONDITION

KAY TERAOKA, YOSHIYUKI YOKOGAWA, TETSUYA KAMEYAMA
Ceramics Research Institute, National Institute of Advanced Industrial Science
and Technology,
2266-98, Shimo-Shidami, Moriyama-ku, Nagoya 463-8560, Japan

Abstract TiO₂-hydroxyapatite composites are noticed for its possibility of environmental applications, because HA adsorbs organic matters, and TiO₂ can decompose organic matters efficiently under irradiation. However, it has been unsolved whether bonding between TiO₂ and HA is good enough for practical use. This study reported a new knowledge on bonding between TiO₂ and HA by demonstrating selective deposition of TiO₂ on the *a*-face of the HA single crystal in hydrothermal condition.

INTRODUCTION

A combination of hydroxyapatite (HA) and TiO₂ can function as effective adsorbent for environmental and antibacterial applications, because HA adsorbs organic matters, and then TiO₂ can decompose organic matters under irradiation. Some TiO₂-HA composites are noticed for its possibility of practical applications.^{1,2} However, present TiO₂-HA composites provide no information about the bonding between HA and TiO₂. Further, it has been unsolved whether bonding between TiO₂ and HA is good enough for practical use. In this study, selective TiO₂ 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 CaHPO₄ (DCP), ultra-pure water as starting materials.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 M Ω /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 *a*-face of the HA single crystal is TiO₂. Bonding between the TiO₂ thin layer and the *a*-face of the HA single crystal was enough tough to survive 5-minut 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 *a*-face of the HA single crystal by the quenching.

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

REFERENCES

- 1 T. Nonami, H. Taoda, N. T. Hue, E. Watanabe, K. Iseda, M. Tazawa, and M. Fukaya, Mater. Res. Bull., **33**, 125 (1998).
- 2 M. Wakamura, K. Hashimoto, and T. Watanabe, Phos. Res. Bull., **10**, 323 (1999).
- 3 A. Ito, S. Nakamura, H. Aoki, M. Akao, K. Teraoka, S. Tsutsumi, K. Onuma, and T. Tateishi, J. Cryst. Growth, **163**, 311 (1996).