Nano-sized calcium phosphates (CaPs) coatings on the anodic oxidized titania porous surface via a microwave irradiation process

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Introduction

Nano-sized calcium phosphates (CaPs) coatings on biomaterials are gaining attentions as nano-structured surfaces enhance the cellular activity more than surface along with micron-sized structure. The hypothesis of this research is that nano-sized CaPs can be precipitated on the anodic oxidized titania porous surface via a microwave irradiation (MI) process.

Materials & Methods

The titania porous surface was prepared by anodic oxidization (280V, 10mA/cm^2) of grade 2 commercial pure titanium discs in electrolytes composed of 0.2M calcium acetate and 0.04M β-glycerol phosphate disodium for 3mins. The titanium discs were microwave irradiated in water (MI-DD) and diluted Ca/P solutions (MI-CP) by a domestic microwave oven (2.45GHz, 1000W, 50%) for 5 and 20 minutes. The morphology, structure, and chemical characters of samples were evaluated by SEM, XRD and FTIR, the results were compared to hydrothermal (HT, 250℃, 3hours) and control (AO, anodic oxidize only) groups.

Results & Discussion

By SEM, numberless nano-sized CaPs precipitates on titania porous surface were obtained on MI-CP (20mins) sample, whereas no precipatate was found on MI-DD samples (Figure 1 (a) and (b)). The nano-sized precipitates are shuttle-like with long axis around 100nm as shown in Figure 1 (c). There are various micron-sized hexagonal rod-like precipitates were found by HT (Figure 1 (d)). The XRD (Figure 2) shows weak hydroxyapatite (HA) peaks at all MI samples (20mins), and FTIR (Figure 3) shows broaden Ti-O, PO_3^{-4}, and OH^- absorption peaks indicates the Ca and P which originally incorporated in the anatase titania were leach-out to precipitate CaPs homogeneously on the porous surface by MI. The XRD of HT samples shows 25.88°, 31.72°,32.19. 32.96° of HA peaks beside anatase and titanium peaks. The FTIR of HT shows sharp absorption peaks of PO_3^{-4} at 566, 604, 1050, 1092 cm^{-1} also confirmed that HA abtained by HT can possess highly crystalline.

Conclusion

Nano-sized CaPs precipitates on titania porous surface were obtained via a microwave irradiation (MI) process. Hopefully the nano-sized CaP precipitates firmly formed on the micron-sized porous titania would benefit to the protein adsorption and osteoblasts differentiation and shortening the osseointegration time.

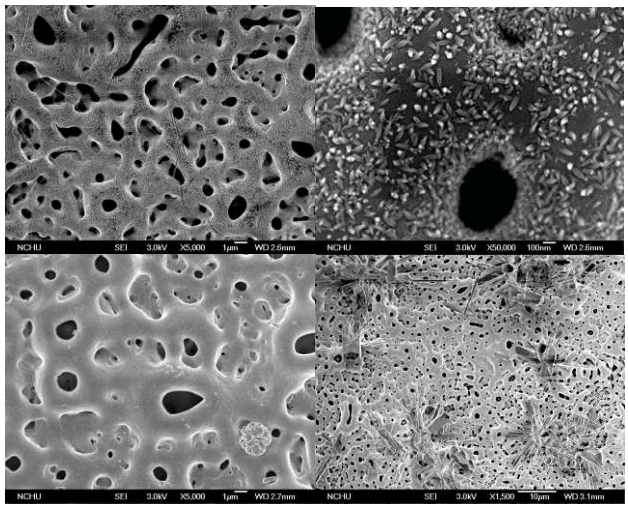

Fig. 1. SEM pictures of (a)MI-CP 20mins, (b)enlarge picture of (a), (c)MI-DD 20mins, and (d)hydrothermal at 250℃ for 3hours.

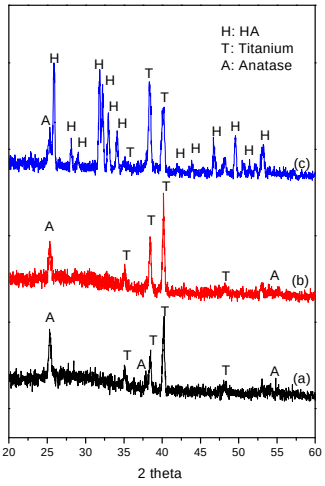

Fig. 2. XRD pattens of samples (a)MI-DD 20mins, (b)MI-CP 20mins, and (c)hydrothermal at 250℃ for 3hours.

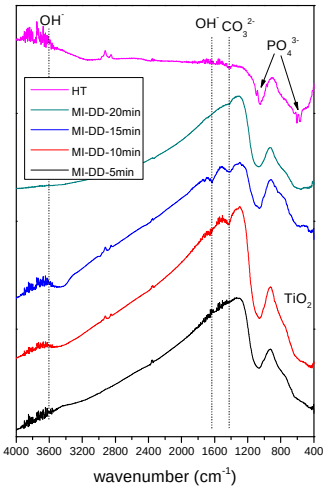

Fig. 3. FTIR spectrums of MI-DD 5, 10, 15, 20mins with compare to HT sample at 250℃ for 3hours.

References

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