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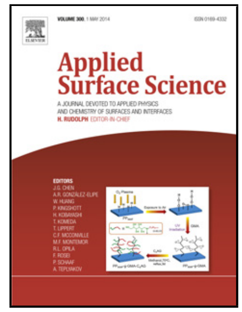

Title: Structure, composition and morphology of bioactive titanate layer on porous titanium surfaces

Author: Jinshan Li Xiaohua Wang Rui Hu Hongchao Kou

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Structure, composition and morphology of bioactive titanate layer on porous titanium surfaces

Jinshan Li, Xiaohua Wang, Rui Hu*, Hongchao Kou

State Key Laboratory of Solidification Processing, Northwestern Polytechnical University, Xi'an 710072, China

Abstract. A bioactive coating was produced on pore surfaces of porous titanium samples by an amendatory alkali-heat treatment method. Porous titanium was prepared by powder metallurgy and its porosity and average size were 45% and 135μm respectively. Coating morphology, coating structure and phase constituents were examined by SEM, XPS and XRD. It was found that a micro-network structure with sizes of <200nm mainly composed of bioactive sodium titanate and rutile phases of TiO_2 covered the interior and exterior of porous titanium cells, and redundant Ca ion was detected in the titanate layer. The concentration distribution of Ti, O, Ca and Na in the coating showed a compositional gradient from the intermediate layer toward the outer surface. These compositional gradients indicate that the coating bonded to Ti substrate without a distinct interface. After immersion into the SBF solution for 3 days, a bone-like carbonate-hydroxylapatite showing a good biocompatibility was detected on the coating surface. And the redundant Ca advanced the bioactivity of the coating. Thus, the present modification is expected to allow the use of the bioactive porous titanium as artificial bones even under load-bearing conditions.

Keywords: Porous titanium; powder metallurgy; biomaterials; Alkali-heat treatment; Bioactivity; Apatite

1. Introduction

There has been an increasing interest in porous titanium substitutes for bone tissue engineering applications because of their superior mechanical properties, low modulus, excellent corrosion resistance and good biocompatibility[1-5]. Porous Ti prepared by powder metallurgy method was actually applied in the interbody fusion of the lumbar spine[6]. However, titanium, being bioinert, cannot directly bond to bone. It becomes encapsulated by a fibrous tissue that isolates it from the surrounding bone after implantation into the living body. The problem can be solved by coating a biologically active bonelike apatite layer on the surfaces of titanium and titanium alloy implants. For the last decades, various bioactive coatings have been prepared on titanium surfaces to provide these bioinert materials with bone-boding ability. In the beginning, almost all of these attempts are physical coating processes in the metals with foreign ceramic materials that have bone-bonding ability: for example, hydroxyapatite(HA), bioglass and so on[7]. The most common technology for actual clinical application is HA coating plasma-sprayed onto Ti alloys performed at high

* Corresponding author at: State Key Laboratory of Solidification Processing, Northwestern Polytechnical University, Xi'an 710072, China. Tel: +86-029-88461764; fax: +86-029-88460294
E-mail addresses: rhu@nwpu.edu.cn (Rui Hu)