

## 19. Corrosion of Biomaterials

### Corrosion behavior of collagen-immobilized interconnected porous titanium alloy scaffold in simulated inflammatory environments

Her-Hsiung Huang, Jia-Yi Wen

*National Yang Ming Chiao Tung University, Taipei, Taiwan*

*beer.huang@nycu.edu.tw*

**Abstract** The implantation of metallic biomaterials in the human body can lead to inflammation of the surrounding tissue. Inflammatory cells attach to the implant surface and release reactive oxygen species (ROS, e.g., H<sub>2</sub>O<sub>2</sub>), leading to a decrease in the ambient pH, which in turn affects the corrosion resistance of the implant. In our previous study, we have demonstrated that 3D-printed interconnected porous Ti-24Nb-4Zr-8Sn (Ti2448) alloy scaffold immobilized with type I collagen promotes osteogenesis. However, the corrosion (or electrochemical) behavior of Ti2448 alloy scaffold under inflammatory conditions remains unclear. Therefore, this study was to evaluate how simulated inflammatory (SI) conditions (containing H<sub>2</sub>O<sub>2</sub> and lower pH) affect the corrosion behavior of 3D-printed porous Ti2448 scaffolds immobilized with type I collagen. Unique surface treatment process, combining alkali treatment and the following type I collagen immobilization via natural crosslinker procyanidin, was applied to electron beam melting process-produced interconnected porous Ti2448 scaffolds. Surface characteristics (including oxide thickness and chemical composition) and electrochemical behavior (by measuring polarization curves and electrochemical impedance spectra) were studied under SI environments containing H<sub>2</sub>O<sub>2</sub> and lower pH. Results showed that alkali treatment created a dense passive film (thickness 200~400 nm) on the surface of Ti2448 scaffolds and then improved the corrosion resistance, in terms of increasing the generation rate and protectiveness of surface passive film, regardless of the pH (7.4 and 5.2) and H<sub>2</sub>O<sub>2</sub> concentration (0 and 150 mM) in the SI environments. Immobilization of type I collagen on Ti2448 scaffolds not only enhanced the osteogenesis but also slightly increased the corrosion resistance in SI environments. We concluded that the presence of acidic pH and H<sub>2</sub>O<sub>2</sub> decreased the corrosion resistance of the untreated Ti2448 alloy scaffolds, while the proposed surface treatment improved its corrosion resistance.

**Keywords** titanium alloy scaffold, corrosion, simulated inflammatory environment