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Abstract

Biomimetic deposition of apatite in simulated body fluid (SBF) in vitro has been widely used to evaluate the bioactivity of titanium (Ti) and prepare a functional coating on biomedical metallic substrates. In this study, the deposition behaviors of hydroxyapatite (HA) on Ti samples treated by alkali and heat treatment (AH) in SBFs (1×, 2×, 3×SBF) at 37, 47 and 57 °C were researched. The electrochemical results confirmed the characteristic fine and porous network structure on Ti substrate after AH resulted in the decrease of corrosion resistance. SEM images showed that the surface structure and morphology of hydroxyapatite (HA) coatings varied markedly under different soaking conditions. Particularly, high SBF concentrations and immersion temperatures created more homogeneous and dense deposited layers with uniform large spherical HA agglomerates. The results of XRD and FTIR demonstrated that brushite (the precursor of HA) preferentially formed and gradually transformed into HA in SBF with high ion concentration and temperature. Thermodynamic analysis in terms of nucleation and crystal growth mechanism was proposed to fundamentally explain HA deposition process in vitro. This work provides a potential method to rapidly evaluate the bioactivity of Ti-based biomaterials and prepare controlled bioactive coating on the implants.

Keywords: Titanium, Hydroxyapatite, Deposition behaviors, Ionic concentrations, Immersion temperatures, Thermodynamics analysis.