OR0401

Evolution of the micro-nano hierarchical surface morphology of titanium during MAO in tetraborate electrolytes

Weiqiang Wang[1], Min Qi[2]

[1]School of Materials, DUT, Dalian, China [2]School of Materials Science and Engineering, Dalian University of Technology, Dalian, China

wangwq@dlut.edu.cn

To looking for an appropriate surface modification to promote osseointegration of titanium implants, micro-arc oxidation (MAO) was made on pure titanium in three tetraborate electrolytes of $Na_2B_4O_7$, $Li_2B_4O_7$, and $K_2B_4O_7$. The morphology, structure, hydrophilia, and biological performance of the coatings were investigated by SEM, XRD, XPS, contact angle measurement and in vitro cellular adhesion test. The surface morphological evolution and the concentration of traceable elements in electrolytes were analyzed. The results show that, compared with the typical volcanic pores formed on surface of titanium during MAO treatment in electrolyte of Na_2HPO_4, the surface morphology evolution of titanium treated in tetraborate containing electrolytes undergoes four stages: 1) uniform nano-scale pores form; 2) dispersive micro-scale pores with no crateriform spray deposition form on the base of nano pores; 3) micro pores transversely grow into slots; 4) micro-scale cortex-like slots form on the surface of titanium. And in the last stage, there are still nano pores distributing uniformly on the surface, i.e., a coating with micro-nano hierarchical structure forms. The delicate structure in different tetraborate electrolyte is a little different; nano pores on shoulder of micro slots in $Na_2B_4O_7$ and $Li_2B_4O_7$ electrolytic solutions keep better. Compared with the Na_2HPO_4 contrast group, the coating prepared in sodium tetraborate containing electrolyte shows super wettability and good cell attachment. A small amount of amorphous B_2O_3 exists in the coating surface and Ti ion concentration tested after MAO in $Na_2B_4O_7$ electrolyte is more than that of comparison group. Therefore, the formation of cortex-like slots on the surface of titanium during MAO in tetraborate containing solutions is probably due to the dissolution of TiO_2 by B_2O_3 at high temperature because of micro-arc discharge. This study was supported by the National Natural Science Foundation of China (Grant No. 51371042).

Keywords
Titanium
Micro-arc oxidation
Biomaterials
Hierarchical structure
Super wettability