Hierarchical architecture on the surface of NiTi shape memory alloy for antibacterial implants

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Statement of Purpose: Biomaterials such as metals, polymers, ceramics, and composites are widely used in tissue repair and reconstruction. Whether or not the biomaterials and surrounding tissues can coexist and produce synergistic effects depends mainly on the compatibility of the artificial biomaterials such as blood compatibility, osseocompatibility, antibacterial capability, and so on. Surface modification can effectively improve the compatibility by changing the surface chemistry, microstructure, and other materials attributes. A critical issue in medical science is bacteria-induced infection during and after surgical operations and it frequently leads to failure of biomaterials and biomedical implants. In fact, microbial infection is becoming the predominant cause of biomaterials failure and there are now over one million infection-related failures annually. In this work, we fabricated a hierarchical nano architectures on the surface of NiTi shape memory alloy to enhance its antibacterial performance.

Methods: Near equiatomic NiTi shape memory alloy was used as starting materials. The hierarchical nano architectures of NiTi was prepared by electrochemical anodic oxidation in the solution composed of 0.5% NH4Fand 2% K_2HPO_4. The antibacterial activity of the Ag/HA composite coatings was evaluated by a spread plate method and a film adhering method. The LUX method was use to evaluate the antibacterial performance. Two kinds of bacteria, Escherichia coli (E. coli) and Staphylococcus albus (S. albus), were used in antibacterial experiments. FESEM and EDS were used to characterize the surface morphology and elemental distribution on the modified surface. XRD was used to characterize the phase composition.

Results:

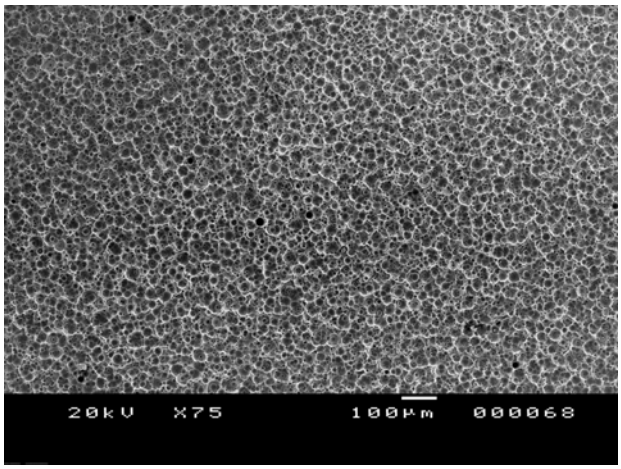

Figure 1(a)

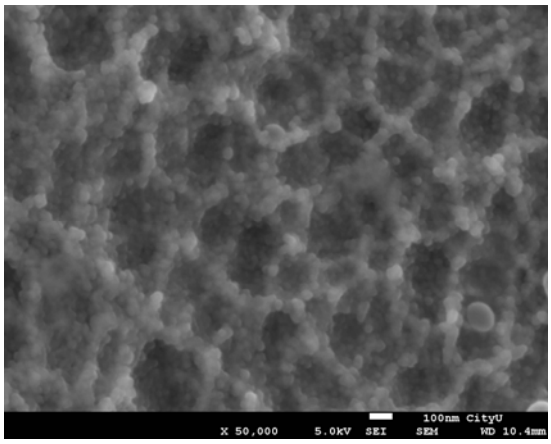

Figure 1 Surface morphology of anodized NiTi

Lux method

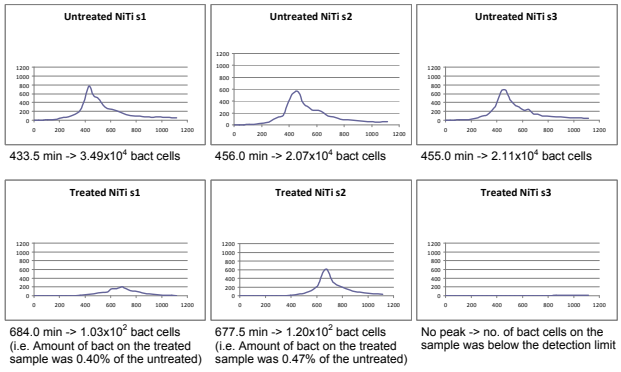

Figure 2. The statistic of antibactetrial results

Conclusions:

A hierarchical architecture was successfully achieved by electrochemical anodization method from micro to nano scale.

Surface hierarchical nano structure are useful to enhance the antibacterial performance of NiTi shape memory alloy.