Enhancing Antibacterial Properties on Micro-/nano-patterned Ti-based Bulk Metallic Glass via Self-organizing Hierarchical Biopolymers for Hard Tissue Implant Applications

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Implant-associated infections are a crucial issue for the failure of medical treatments which leads economic and social associated costs.[1] Bacterial adhesion and biofilm formation are important steps for the development of implant-related infections.[1] Titanium-based bulk metallic glasses (BMGs) have attracted much attention for future medical applications such as orthopedic implants for prosthesis, fixation, and dental implants, thanks to its specific mechanical properties and superior biocompatibility.[2,3] In this work, a new concept of biomaterials is proposed to handle this problem. Biocompatible Ti-based BMG without toxic elements such as Ni, Al and Be were cast under high purity conditions. The cast BMG were thermo-mechanically characterized to determine the proper processing temperature and time for compression molding-based thermoplastic net-shaping (TPN) without crystallizing its amorphous structure.[4,5] To generate micro-/nano-patterned surface features, the cast BMGs were then processed in the supercooled liquid region (SCLR) with an optimized template.[4,5] The patterned surface features were characterized by scanning electron microscopy and contact angle measurements. Furthermore, functionalization of surfaces with hydrophilic polymers such as polyethylene glycol (PEG) has shown its potential to improve the biocompatibility and antifouling properties of biomedical materials.[6,7] Hence, in this research, PEG-based biopolymers were spin-coated on the patterned surface of BMG and then annealed under different temperatures and times to induce self-organizing hierarchical structures. The final self-assembled hierarchical structures were characterized by polarized light microscopy and confocal laser microscopy. This new strategy aims to enhance antibacterial properties and inhibit biofilm formation for hard tissue implants in biomedical application.

Reference:

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