Corrosion resistance and cell proliferation of Ti6Al4V alloy manufactured by Selective Laser Melting and processed through High-Pressure Torsion

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Additive manufacturing titanium alloy Ti6Al4V has attracted extensive interests for biomaterials applications. As the defects, such as uneven surface or porous microstructure, are intrinsic for the materials manufactured by selective laser melting (SLM) technology, high-pressure torsion processing (HPT) was applied to reduce defects or pores as well as to improve the mechanical properties of the materials. The main objective of this report is to evaluate the efficiency of HPT processing on corrosion performance and in vitro cell viability of SLM manufactured Ti6Al4V alloy in physiological conditions for biomedical applications. Ti6Al4V samples were firstly fabricated by SLM process and subsequently processed by HPT at room temperature under a constant pressure of 6 GPa for 10 torsional revolutions at 1 rpm. Electrochemical testing using open-circuit potential (OCP), electrochemical impedance spectroscopy (EIS) and potentiodynamic polarization techniques, was performed in a phosphate buffered saline (PBS) solution on all the processed samples including conventionally forged Ti6Al4V. Cell proliferation tests were investigated with MG63 human osteoblast cell in a culture medium made by adding 1% penicillin (for antibiosis) and 10% fetal calf serum (FCS, for cell proliferation enhancement) into Dulbecco's modified Eagle's medium (DMEM), and analysed using fluorescent microscopy after staining process.

The electrochemical testing results demonstrated that SLM manufactured Ti6Al4V exhibited significantly greater corrosion resistance in PBS solution than the conventionally forged samples. HPT processing slightly deteriorated corrosion resistance of the SLM manufactured Ti6Al4V, but HPT processed samples still have greater corrosion resistance than the conventionally forged Ti6Al4V. Cell proliferation testing results demonstrated that both SLM manufacturing and HPT processing slightly increased the proportion of viable osteoblast cells on Ti6Al4V surface, which is in well agreement with contact angles changes.