HIP Post-Processing of SLM-Produced Ti-6Al-4V Alloy for Biomedical Applications

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Selective Laser Melting (SLM) technology offers important improvements in making Ti-6Al-4V alloys for medical use. This study focuses on the mechanical properties of 3D-printed Ti-6Al-4V alloy, which are crucial for its potential applications in orthopedic implants. The SLM method can produce implants of a variety of shapes and sizes tailored for individual patients. Additionally, the SLM method allows for the creation of porous structures, which reduces the elastic modulus, preventing the undesired stress-shielding effect. We tested three SLM-produced Ti-6Al-4V alloy samples post-processed by Hot-Isostatic Pressing (HIP) at different temperatures between 850-950°C to determine how it affects microstructure, internal defects, and resulting mechanical properties. The results show that HIP treatment transforms the α' martensite into a dual phase α(Ti)+β(Ti) microstructure and significantly reduces internal porosity. As a result, ductility increases, and tensile strength decreases after HIP. This research shows that SLM-produced and HIP-post-processed Ti-6Al-4V alloy is a promising bio-inert material for orthopedic implants.