Ti6Al4V-Ag 3D Multi-Materials fabricated by Laser Powder Bed Fusion for Biomedical Applications: Mechanical and biological characterization

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Abstract:

Biomedical implants often face two major challenges after implantation: post-surgical infections and poor osteointegration.

Recent advances suggest that applying electrical current is a promising strategy to address both complications. In this context, a new implant design is proposed that combines the intrinsic properties of Ti6Al4V and Ag(silver). Ti6Al4V, a titanium alloy, is widely used for implants because of its mechanical properties and biocompatibility, whereas silver is recognized for its antibacterial characteristics and high electrical conductivity.

This study explores the fabrication of Ti6Al4V-Ag 3D multi-materials by Laser Powder Bed Fusion, with emphasis on optimizing processing parameters and controlling the transition zone to ensure metallurgical integrity and reliable functionality.

The obtained multi-materials were characterized in terms of microstructure, phase distribution, porosity, hardness, and other relevant mechanical and physical properties. Silver incorporations provide electrical conductivity that enables therapeutic currents to be applied directly through the implant.

The results demonstrate that this approach is effective in producing Ti6Al4V-Ag 3D multi-material with embedded electrical functionality. This opens a pathway for real-time stimulation aimed at both reducing bacterial activity and enhancing osteointegration. Overall, this work highlights the potential of Additive Manufacturing to deliver next-generation multifunctional biomedical implants combining structural reliability, antibacterial protection, and compatibility with electrical stimulation therapy.

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