A comprehensive assessment of laser welding of biomedical devices and implant materials: recent research, development and applications

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ABSTRACT

This review comprehensively covers the research accomplished in the field of laser welding of biomedical devices and implant materials. Laser welding technology in the recent past has been envisaged for numerous biomedical applications encompassing the reconstruction, fabrication, joining and sealing of the implanted biomaterials. It is the most studied and an increasingly applied manufacturing technology that garners the distinct advantages of smaller beam diameters leading to minimal thermal cycles that reduce the size of heat affected zone and instigate microstructural refinement. This paper presents a detailed critical review of similar and dissimilar welding of titanium alloys, cobalt-chromium alloys, steel, bulk metallic glasses and polymer-based biomaterials. Mechanical properties of the welded joints such as fatigue load, tensile and flexural strength, elongation, hardness and modulus of elasticity are discussed. The effect of laser processing parameters on microstructural features and the corresponding metallurgical defects encountered such as cracks, porosities, voids or the loss of alloying elements are reviewed. Furthermore, the corrosion behavior, cytotoxicity and biocompatibility of the welded implants in the simulated mediums are discussed. Furthermore, this article also summarizes the present-day applications associated with implant materials and is aimed at the further involvement of the laser precision technology in producing materials and joints with desired biomechanical characteristics. Lastly, the current research gaps on the role of laser welding of implants and the anticipated emerging fronts are summarized.

KEYWORDS: Laser welding; biomaterials; mechanical properties; biocompatibility

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