Mechanical behavior of selective laser melting-produced metallic biomaterials

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5.1 Introduction

Biomaterials are substances used to repair damaged body parts through interaction with living systems. Advanced manufacturing techniques for biomaterials processing are continually being explored to minimize inventory, reduce cost, and achieve desired material properties. Selective laser melting (SLM) is currently the most popular powder bed fusion technique for manufacturing biomaterial metal products, as compared to other metal additive manufacturing (AM) methods [1–3]. Studies of SLM for metallic biomaterials are numerous and new research continues to appear [2, 4] as the technology matures, due to the advantages of SLM, such as high build resolution, excellent dimensional accuracy, clean build environment, low excess materials, and near-net-shape capability. The growth of SLM systems is related to new machinery developments and innovations to make the technology more productive and economically attractive. The new technology development and well-developed innovation for machine utilization became significant as the growth reached the year 2012 [5]. It included the in-house production of SLM systems for research involving metallic biomaterials such as cobalt-based alloys and nickel-titanium.

One of the unique things about the SLM process is its capability to manufacture complex geometrical structure instead of just simple, fully dense parts [6]. The structural design of the part is believed to influence the biomaterials in meeting specific mechanical characterizations directly [7, 8]. Therefore a great deal of research has explored the remarkable potential of SLM in manufacturing of difficult porous biomaterial parts. Ti6Al4V has become the most in-demand biomaterial used in porous structure fabrication using the SLM process.

This chapter reviews the roles of the SLM process in manufacturing various metals from the biomaterials family to develop their mechanical behavior. The review begins by introducing SLM mechanisms and addressing the processing parameters that influence the mechanical properties of metallic biomaterial parts. Then, the following discussion focuses on three different categories of SLM parts: fully dense (solid), porous,

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