Mechanical Properties of 3D Printed Titanium Alloy Parts Manufactured by Selective Laser Melting (SLM) for Potential Orthopaedic Applications

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INTRODUCTION:

Selective laser melting (SLM) is a type of Additive Manufacturing (AM) technology that deposits materials layer by layer towards production of a 3D structure. In orthopaedic field, titanium (Ti) based implants is widely used in orthopaedic surgery due to their excellent properties and biocompatibility. This study aimed to investigate the mechanical properties of 3D printed titanium alloy parts through SLMed technology.

MATERIALS & METHODS:

Mechanical properties of the 3D printed specimen includes Vickers hardness, tensile strength, and Modulus Young values were evaluated. The hardness value of the sample was measured using MECHATEC-DV-5C Auto Turret Digital Display Vickers Hardness. The cross section of sample was cut, grinded and polished until obtaining clear surface finishing. The tensile strength and Modulus Young properties of the sample was measure using Universal Testing Machine, INSTRON 5969 according to ASTM E8/E8M with testing speed at 2.00mm/min. Scanning Electron Microscope (SEM) was used to investigate the microstructure of the sample.

RESULTS:

The measurement value hardness average for all the printed sample has achieved 460.97 ± 4.55 Hv. As for the tensile strength of 3D printed titanium alloy, the value shown in range of 1618 to 1661 MPa. While the Modulus Young values of the samples were in range of 96310 to 96570 MPa.

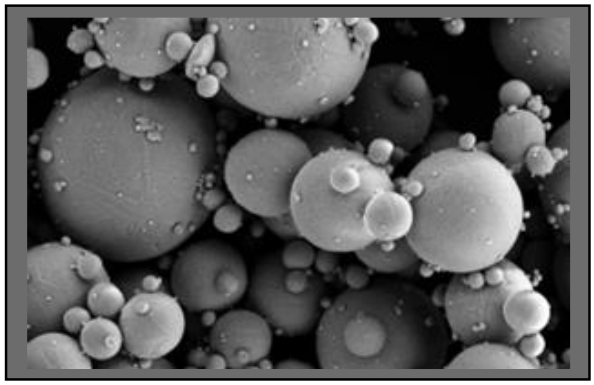

Figure 1: A scanning electron micrograph image of Ti6Al4V powder at 1000x magnification

DISCUSSIONS:

The high hardness can be attributed due to the lower porosity percent and vice versa. Inconsistency of hardness value between each sample may be contributed by occurrence air trapped during fusion process by different size of interparticle metal powder that influences efficiency interlocking particle metal powder at powder-bed. As for tensile strength and modulus young for 3D printed titanium alloy sample, the high tensile strength value of this sample may be contributed due to the factor of low porosity.

CONCLUSION:

The present study reveals the mechanical properties of the 3D printed Titanium Alloy SLMed technology has a good potential to function as orthopaedic implant in future.

REFERENCES:

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