Effect of Elementary Cell on Stress Concentration in Ti6Al4V Lattice Structure

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ABSTRACT

Additive manufacturing (AM) allows to fabricate extremely complex structures, offering designers the greatest possible freedom. Among these complex designs, lattice structures possess good mechanical and functional properties, such as high specific strength, lightweight, and shock absorption, that make them ideal candidates for medical, mechanical, and aeronautical applications [1]. The mechanical and functional properties of lattice structures are however dependent on different factors as elementary cell's topology and relative density, boundary and loading conditions, and fabrication process parameters.

The present work aims to investigate the effect of the relative density of the elementary cell on the mechanical material properties of the lattice structure fabricated by AM.

An experimental investigation is first performed on Ti6Al4V lattice structures produced by Selective Laser Melting (SLM) and heat treated at 850°C for 2 hours. Two elementary cells, representative of two values of relative density, in lattice samples and full density dog-bone shaped samples are considered. Then, a numerical finite element analysis is performed.

The obtained results allow to provide useful insight into the deformation/failure mechanisms, stress concentrations, and mechanical properties of the studied structures as well as into their correlation to the relative density and printing process parameters.

REFERENCES

[1] L.J. Gibson and M.F. Ashby, Cellular Solids: Structure and Properties, Cambridge University Press, 1997.