20th European Mechanics of Materials Conference - EMMC20
Florence, Italy | May 27th-29th, 2026
www.emmc20.unifi.it

Dimensional accuracy and compression behaviour of copper BCC lattices produced via Laser Powder Bed Fusion, characterized through Digital Volume Correlation

Frederik Vanherf[1], Michel Smet[2], Brecht Van Hooreweder[3], Aude Simar[4]

[1] KU Leuven and UC Louvain, Belgium. frederik.vanherf@kuleuven.be
[2] KU Leuven, Belgium. michel.smet@kuleuven.be
[3] KU Leuven, Belgium. brecht.vanhooreweder@kuleuven.be
[4] UC Louvain, Belgium. aude.simar@uclouvain.be

Paper ID: 263
Symposium S6: Additive manufacturing: challenges and solutions

Abstract

Laser Powder Bed Fusion (LPBF) of pure copper enables manufacturing of complex geometries. Because of the excellent electrical and thermal conductivity, this technology is gaining attraction in thermal management solutions and electromagnetic applications. However, a major drawback of copper is its high density, while weight restrictions are frequently imposed for many applications. Strut-based lattices are proposed as a possible solution, aiming to achieve a weight reduction while maintaining local high performance. In addition, these lattices provide a high strength-to-weight ratio, as well as allowing for local densification leading to tuned local properties. In this study, a DoE was set up for manufacturing Body Centered Cubic (BCC) lattices, varying the Unit Cell Size (UCS) from 2 to 10 mm and the volume fraction (VF) from 25 to 75%. Additionally, adapted scanning strategies were introduced, including continuous contour scanning mode, to further increase dimensional accuracy, relative density and reduce shape irregularities. Furthermore, point scan BCC lattices with UCS 1 and 2 mm were built to identify the physical minimum strut diameter, which acts as the lower limit for compensating the CAD-part mismatch. Computed tomography (CT) scans of each UCS and VF combination will visualize the porosity distribution and quantify the deviation from the designed geometry. The effect of the newly implemented contour mode on

deformation behaviour and the mechanical properties of BCC lattices with UCS 2 mm (both VF 25% and points scan) is investigated with the use of in-situ CT compression testing. Digital Volume Correlation is performed to track strain concentrations and understand deformation and failure mechanisms. In addition, introducing contour mode drastically improved their surface quality and reducing VF mismatch. The contour mode improvements are attributed to reduced overheating at the connection point of subsequent vectors, causing less melt pool inhomogeneity, which in turn reduces surface irregularities. It is hypothesized that lattices built with contour mode will possess lower compressive stress concentrations and exhibit a more predictable deformation behaviour. These improvements for strut-based copper lattices are crucial to obtain more reliable and accurately manufactured products.

Keywords:

Laser Powder Bed Fusion Pure copper Weight reduction Digital Volume Correlation Compressive testing Lattice structures