

IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)

Space Structures II - Development and Verification (Deployable and Dimensionally Stable Structures) (2)

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A NOVEL LATTICE SANDWICH CYLINDER SUBJECTED UNIAXIAL COMPRESSION AND ITS
EXPERIMENTAL AND NUMERICAL ANALYSIS**Abstract**

As an additive manufacturing process, selective laser melting (SLM) is becoming more and more attractive in aerospace engineering due to its many advantages, such as rapid prototyping, freedom of design and geometry accuracy. It is especially suitable for complex structures, such as lattice structures and multi-functional structures, and has been widely applied to fabricate aerospace structures including brackets and rocket propulsions. However, the primary structures occupy most of dry weight in spacecrafts while the relevant report about SLM process is little. A novel cylinder subjected uniaxial compression load is proposed and can be fabricated through SLM process. It is a lattice sandwich cylinder with 500mm diameter which lattice core is multi-layered. The critical loads for its various failure modes are carefully deduced, including Euler buckling, macro buckling, skin wrinkling, skin dimpling and skin yield. Based on it, the sizes of the lattice sandwich cylinder are optimized by introducing some constraints of SLM process. Then, the cylinder is fabricated through S600 machine in Bright Laser Technology Company. Its raw material is AlSi10Mg and the mechanical properties along longitudinal direction and transverse directions are measured through three coupon samples. Meanwhile, in order to determine the influence of lattice imperfections, micro-CT is adopted to acquire the actual shape of the lattice samples with various sizes. The relationship between fabricating imperfection and mechanical properties is established by compression tests of pyramidal lattice samples. Finally, uniaxial compression test of the lattice sandwich cylinder is operated. Finite element model is also established by considering lattice imperfection. Both critical load and failure mode are calculated through implicit nonlinear analysis in commercial software ABAQUS, which are highly agreement with experimental results. By comparing with a CFRP cylinder with the same sizes, the novel lattice sandwich cylinder is far more efficient by elaborative design. It also proves that SLM process has wide prospect in the primary structures of spacecrafts.