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Modelling and simulation of the fatigue usage factor of y-TiAl alloy fabricated through Laser Additive Manufacturing (LAM)

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Abstract

Recently, laser additive manufacturing (LAM) technologies are increasingly being applied for producing components with excellent physical and mechanical properties in the aerospace, automotive and energy industries. This work is aimed at modelling the fatigue usage factor of -TiAl alloy fabricated through LAM. The modelling and simulation were performed using the COMSOL Multiphysics 5.4 software by developing a -TiAl alloy microstructure. This was modelled to generate the material properties (density, heat capacity at constant pressure and thermal conductivity) from the microstructure of a unit cell as a general representation of the alloy. The computed properties were used in modelling the LAM process to fabricate -TiAl alloy part with subsequent fatigue simulation to determine the usage factor (Ke). From the models, the maximum Von Mises stress and transient temperature were 2.88 x108 Nm-2 and 1510 K respectively, for the LAM fabrication process, while the fatigue usage factor model showed a maximum Von Mises stress of 2.91 x108 Nm-2 and a fatigue usage factor of 0.35.