

Introduction of SLM process

Selective laser melting (SLM) is one of the new additive manufacturing techniques that emerged in the late 1980s and 1990s. During the SLM process, a product is formed by selectively melting successive layers of powder by the interaction of a laser beam. Upon irradiation, the powder material is heated and, if sufficient power is applied, melts and forms a liquid pool. Afterwards, the molten pool solidifies and cools down quickly, and the consolidated material starts to form the product. After the cross-section of a layer is scanned, the building platform is lowered by an amount equal to the layer thickness and a new layer of powder is deposited. This process is repeated until the product is completed.

This layer-by-layer process was first used to produce prototypes, but the trend is towards direct manufacture of components because of its ability to net-shape manufacture complex structures from a CAD model and a wide range of materials without the need of expensive tooling and machining so that the delay between design and manufacture is minimised. Another advantage is that the powder is melted only locally by the laser and the rest of the powder can be recycled for further fabrication. So far, here in AMPLab at the University of Birmingham, SLM has been used to selectively melt nickel-based superalloys, Ti-based alloys, Al-based alloys and Nb-based alloys to fabricate components and structures for automobile and aerospace application.

SAMULET 3.4

Project Description

SAMULET 3.4 is a TSB funded project to identify the optimum processing parameter and support structure for fabrication of T700 Vanes using SLM. The project involved investigation of the influence of laser processing parameter and laser scanning strategy on the microstructure and structural integrity (such as porosity) of as-fabricated Ti-6Al-4V alloy samples and the study of the influence of post-build heat treatment and hot isostatic pressing on structural integrity, microstructure and mechanical properties such as tensile, low cycle fatigue, crack propagation properties and fracture behaviour. Support structures were designed to withstand enormous stress buildup during SLM and to ensure successful fabrication of T700 vanes. Surface roughness measurement, distortion measurement by GoM laser scanning and residual stress measurement using synchrotron X-ray diffraction would also be carried out.

Key partner: TSB and Rolls-Royce plc

Total Budget: 250K

Team member: Moataz.M.Attallah, Nick.Adkin, Chunlei Qiu

Additive Manufacturing of Aluminium Alloys and Nickel Superalloys

Project Description

This project is funded by Microturbo for the research and investigation into the usage of high temperature Al alloy and Ni superalloys in the manufacture of components using SLM. Investigations into how the amount of cracks, porosity, and mechanical properties are affected by processing parameters and scanning strategy are performed. Tomography is used for the characterisation of the shapes as well as macro distribution of cracks and porosities in the laser fabricated components. Tensile and creep tests, distortion measurement by laser scan and comparison of surface treatments for laser fabricated material are proceeding.

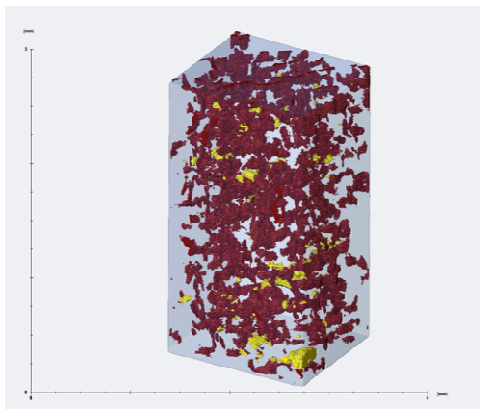


Fig.1 The geometry of the cracks and porosities in laser fabricated Ni superalloy, obtained by X-ray tomography. Red part shows the cracks and yellow part shows the porosity.

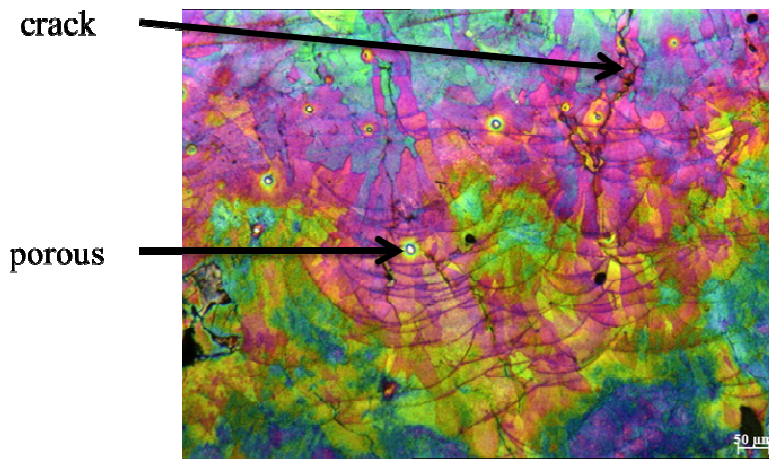


Fig.2 The Microstructure of laser fabricated Al alloy. Sample was etched by Weck's reagent.

Key Partner: Microturbo

Budget: £355 k (2011), and £455 k (2012).