Consolidation Of Metal Alloy Powders Into Functional Components Via Laser Based Additive Manufacturing (AM) Technique

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Additive manufacturing (AM), commonly known as 3D printing is fast gaining popularity as a manufacturing technique.

There are currently 7 types of additive manufacturing techniques defined by the ASTM, all share a commonality, that components are produced in fine layers, driven from a CAD (computer aided design) model. Components can be built in various materials including plastics, ceramics and metals depending on the method used.

Laser powder bed fusion (LPBF) falls into the 'powder bed fusion' ASTM category; components are built up by first dosing a thin layer of metal powder, generally in the size range 15 µm – 45 µm, across a build plate of the same material. A high-power laser then melts selected areas of the powder layer, according to the CAD model which has been sliced using process specific software. This process of layering powder and laser melting is repeated hundreds of times until the solid metal component has been built.

Adoption of LPBF AM is largely due to the associated design advantages over more traditional methods, enabling highly complex geometries not possible to manufacture by any other method, allowing for component weight reduction, consolidation of multiple parts in to a single design and customisation of components. These multiple benefits are applicable to a wide range of industries including, medical, aerospace and tooling.

The metallurgical properties of the components produced must be investigated and understood. Unlike production of a billet for machining for example, the AM components may have a very different microstructure due to the processing methodologies as the layers are rapidly melted and cooled. To control and manipulate the microstructure of the metal produced, processes carried out pre-build, whilst, and post building can be applied in order to control the reliability and repeatability of AM as a production method.