1. Selective Laser Melting of Ti2448 – why is it so hard

Selective Laser Melting (SLM) is an advanced additive manufacturing technology that fabricates parts in a layer-wise manner, directly from a computer solid model and without the need for any machining or an expensive tool or die set. During the manufacturing process, powder is melted using a high intensity laser beam that traces the geometry of each cross-section. After exposure of a layer, the build chamber descends ~50 μm, a fresh layer of powder is spread on top and the next layer is produced. This process continues until the part is complete. The geometric freedom of advanced additive manufacturing technologies, such as Selective Laser Melting, facilitates the generation of structures that were hitherto considered to be either impossible or uneconomical to produce. It has freed designers from many of the constraints imposed by the manufacturing process and permits them to create designs based purely on function. One of the major applications of SLM is for the production of patient specific implants. Ti2448 is a new generation of biomedical grade titanium alloy that has the potential to provide significant improvements as an implant material. However processing of this alloy using Selective Laser Melting is far inferior to the conventional Ti-6Al-4V. The aim of this project is to understand why.

2. Selective Laser Melting of Al Metal Matrix Composites

The aim of this project is to prepare and to investigate the microstructure and mechanical behaviour of aluminium matrix composites (AMC) made by Selective Laser Melting (SLM). AMC reinforced by particles have received considerable attention because of their superior mechanical properties over monolithic aluminium matrix. Selective Laser Melting (SLM) is an advanced additive manufacturing technology that fabricates parts in a layer-wise manner, directly from a computer solid model and without the need for any machining or an expensive tool or die set. A conventional aluminum alloys will be selected as matrix and Al2O3 will be chosen as the reinforcing phase. The effect of the various processing parameters (i.e. scanning strategy, laser power, scan speed, etc) will be studied in order to understand the interaction of the laser beam and powder. The microstructure and mechanical properties will be detailed investigated to build up a processing-microstructure-property map of the ACM prepared by SLM.

3. Cause and Prevention of Particle Ejection during Selective Laser Melting.

Selective Laser Melting (SLM) is an advanced additive manufacturing technology that fabricates parts in a layer-wise manner, directly from a computer solid model and without the need for any machining or an expensive tool or die set. During the manufacturing process, powder is melted using a high intensity laser beam that traces the geometry of each cross-section. After exposure of a layer, the build chamber descends ~50 μm, a fresh layer of powder is spread on top and the next layer is produced. During processing, small particles are often ejected from the build area and land on neighbouring parts, causing a defect in the part. The aim of this project is to gain an understanding of the cause of this phenomenon and devise a strategy to overcome it.
4. **Electro polishing of parts produced via Selective Laser Melting**

Selective Laser Melting (SLM) is an advanced additive manufacturing technology that fabricates parts in a layer-wise manner, directly from a computer solid model and without the need for any machining or an expensive tool or die set. During the manufacturing process, powder is melted using a high intensity laser beam that traces the geometry of each cross-section. The relatively poor surface finish of these parts is one of the main disadvantages of the process. Conventional mechanical surface finishing techniques are usually not practical due to the high geometric complexity of the parts. Hence, the aim of this project is to investigate the use of electro polishing as a method of improving surface finish and then determine its effect on the static and dynamic properties.

5. **Design of a Powder Heating System for Selective Laser Melting.**

The aim of this project is to design a new powder heating system for our SLM equipment that is capable of heating powder to ~600°C. Due to limitations in the equipment, the heating will need to be done from above. The project will involve design and specification of the heaters, measurement and control system and mounting method. During implementation, testing and verification will be performed and then initial testing.