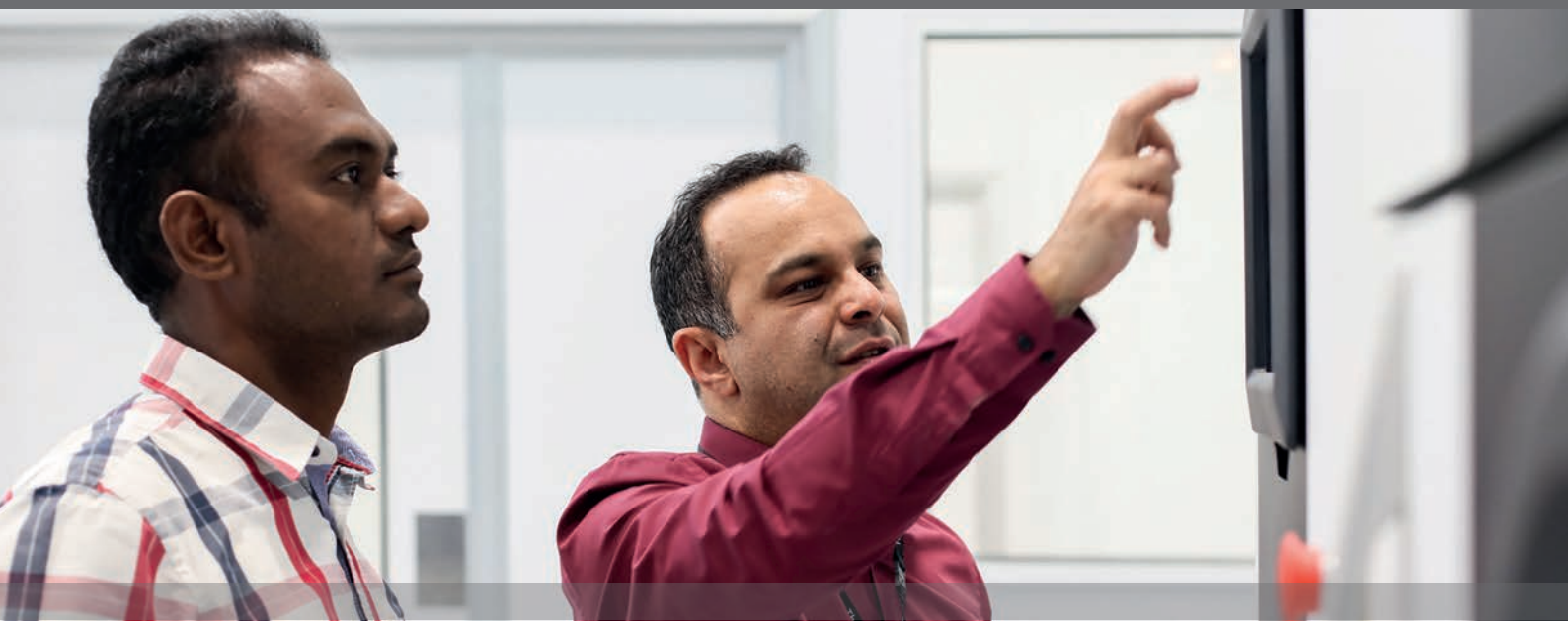
HENRY ROYCE INSTITUTE
ADVANCED METALS PROCESSING

Developing the use of Titanium Aluminide in Additive Manufacturing (3D printing)



The Challenge

With its excellent elevated temperature properties, low density, high stiffness and good oxidation resistance, titanium aluminide is an attractive material for use in both aero engines and high-end automotive applications, particularly in high temperature applications.

Titanium aluminides (TiAl) are currently used in high temperature applications where there is a need to retain good mechanical properties, even in corrosive environments. Their strength-to-weight ratio makes them suitable for applications where weight savings are key, such as aerospace components and turbo chargers. Traditional casting methods involve lengthy process chains with high costs of feedstock materials. Additive Manufacturing (AM) represents an effective alternative due to reuse of raw materials and near net shape fabrication. TiAl however requires a controlled processing environment. Atmospheric conditions and high temperature profiles are essential in order to avoid oxidation and thermal stresses (crack formation) when forming real parts.

Working with the University of Sheffield

Compared to traditional processes, AM offers improved production times. Metron is working with the Royce Translational Centre team at The University of Sheffield to develop protocols to produce TiAl components with uniform microstructure and desired properties.

How the Royce Translational Centre is addressing the challenge

The Arcam Q10Plus is a new generation of electron beam AM equipment and is located within the Royce Translational Centre, part of the Royce@Sheffield facilities. This equipment is able to process materials at high temperatures, hence reducing manufacturing risks mentioned previously.

However, the challenge is to develop a suitable protocol to produce the desired part from TiAl powder.

Using the expertise within the Royce@Sheffield team, Metron engineers are working on the Arcam Q10Plus machine to develop a reliable process through the design of experiments and parametric research. For example, they have looked at a step series for powder preheating and melting at a high temperature, the study of powder degradation and the full assessment of solid components through experimental techniques.

A solution for industry

Working together and combining AM expertise from the University with the capability of the Royce Translational Centre and the industrial knowhow at Metron, the team has successfully used electron beam AM technology with TiAl powder to achieve high density components, and assessed mechanical properties in "as built" conditions. They have also successfully assessed powder degradation in order to allow reuse of raw materials, essential to the efficiency of 3D printing. Further work is required to optimise the manufacturing of TiAl parts using electron beam AM. Metron engineers will continue to work with the Royce@Sheffield team to develop protocols to produce parts that have the required microstructure and properties.

The Knowledge Transfer Partnership between the Department of Materials Science and Engineering and Metron, and the access to the Arcam Q10plus equipment located within the Royce Translational Centre, has the aim of transferring AM knowledge to the industry, and ultimately providing new market opportunities.