Advanced Metallic Systems CDT

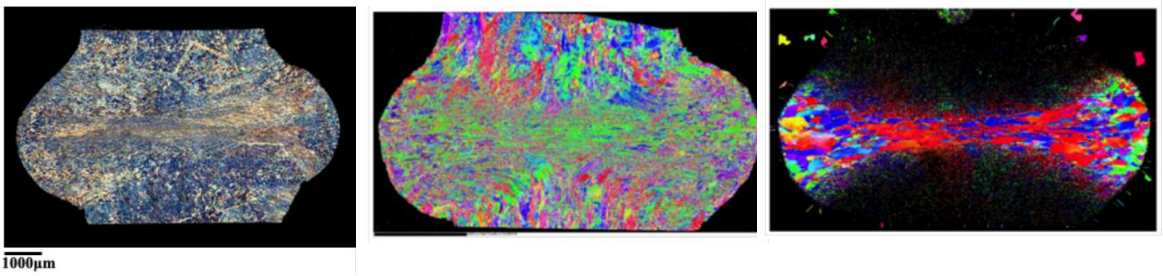
PhD in Microstructure evolution during forging high performance Ti aerospace components.

Supervisors: Dr João Quinta da Fonseca, Professor Brad Wynne and Progressor Philip Pragnell
Collaborator: Titanium Hot Fundamentals Consortium
Based at: The University of Manchester
Stipend: Current UKRI stipend plus a top-up of £2,500p.a. in year 1, and £3,500p.a. in Years 2, 3, and 4, for UK and eligible EU students.
Open to: Candidates with a strong degree in Materials Science, Physics or Mechanical Engineering with an interest in characterisation and data analysis.

The CDT in Advanced Metallics is a partnership between the Universities of Sheffield and Manchester and the I-Form Advanced Manufacturing Centre, Dublin. CDT students undertake the CDT training programme at all three locations throughout the 4-year programme.

With their unrivalled strength-to-weight ratio, titanium alloys make up much of the frame of many modern aircraft and are indispensable in their jet engines. Nevertheless, titanium metallurgy is less well understood that of steel and other alloys based on aluminium. Partly, this is because Ti alloys are more specialised and therefore have been less studied. But, another reason is that Ti alloys are very complex, containing hierarchical microstructures which change dramatically during the processing and manufacturing of components. This complexity means that the behaviour of Ti alloys is difficult to predict and they are processed using routes that have been developed empirically, by trial and error.

Microstructure variation in Ti alloy sample after upsetting by 50% at 950C . Optical micrograph (left), alpha orientation map (middle) and beta orientation map (right).



This PhD project is part of a larger research project in LightForm (lightform.org.uk), that aims to develop new models for predicting how the microstructure evolves in these important alloys during processing at high temperatures. This larger project brings together end users of Ti alloys like Airbus and Rolls-Royce, and material producers and manufactures like TIMET and Aubert & Duval, with the common goal of developing new predictive tools for process and alloy development.

During your PhD, you will study the development of microstructure in Ti alloys during processing using state-of-the art process simulators and characterisation techniques. The aim is to develop a better understanding of the physical processes responsible for the changes in microstructure, by gathering new unique experimental data under controlled conditions. This data will be used by other researchers in LightForm to develop and validate new models of microstructure evolution.

You will use state-of-the-art thermo-mechanical simulators and electron microscopy and diffraction to characterise titanium microstructures at different length scales and in 3 dimensions. To study

their development during deformation, you will use synchrotron diffraction to make fast measurements during process simulations. Although this is primarily an experimental research project, you will also have the opportunity to develop computational data analysis skills.

You will be part of a team of nearly 20 researchers researching titanium alloys at the universities of Manchester , Cambridge and Imperial College London. You supervisory team is made up of Ti experts in Manchester and Sheffield. The project is sponsored by a consortium of 6 different companies and therefore it provides ample opportunity to develop professional and academic networks during your studies.