Advanced Metallic Systems CDT

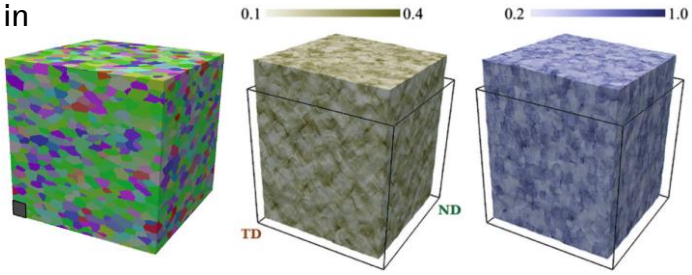
PhD in Modelling the microstructure evolution during hot working of Ti alloys.

Supervisors: Dr Pratheek Shanthraj and Dr João Quinta da Fonseca
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 Applied Mathematics, Materials, Physics or Mechanical Engineering with an interest in computational modelling.

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.

Given their unrivalled strength-to-weight ratio, titanium (Ti) alloys are indispensable to the aerospace industry. They are used extensively in the modern aircraft, with applications ranging from frame structures to jet engine components. However, Ti alloys are very complex, containing hierarchical microstructures which change dramatically during the processing and manufacturing of components. This complexity makes their behaviour difficult to predict and forces manufacturers to rely heavily on processing routes that have been developed through trial and error. As a result, compared to more mature steel and aluminium alloys, Ti metallurgy is still in its nascent stages of development.

This PhD project is part of a larger research effort in LightForm (lightform.org.uk) that aims to develop new models to predict 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, with material producers and manufactures like TIMET and Aubert & Duval, towards the common goal of developing new predictive tools to guide and accelerate process and alloy development.



Local stresses (right) and strains (mid) mapped onto the deformed configuration of the 30% cold-rolled and recrystallized representative volume element (left). Simulations performed using DAMASK.

During your PhD, you will use computational modelling to study the microstructure evolution of dual phase Ti alloys during warm deformation. You will start by using full-field crystal plasticity modelling to understand the mechanical interactions between crystals and phases. Later, this will be combined with phase-field modelling to include chemical and diffusional effects like grain boundary movement. This work will be performed using the DAMASK simulation suite (damask.mpie.de), and you will have the opportunity to contribute to its development. You will work closely with other PhD students and senior researchers, using their data to help develop new models and obtain materials parameters.

You will also have access to high-performance computing facilities at the University of Manchester and national facilities.

You will be part of a team of nearly 20 researchers doing research on titanium alloys at the universities of Manchester, Cambridge, and Imperial College London. 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.