Title: **Improving design against stress corrosion cracking in additively manufactured parts**

Supervisors: Dr. Hector Basoalto and Dr. David Gonzalez

Project Description:

Additive manufacturing (AM) introduces a range of variabilities which have an impact on the mechanical performance of components such as residual stresses, microstructural variation and porosity. This can lead to premature failure under cyclic loading or stress corrosion cracking. The stress corrosion performance is highly dependent on the microstructure and the residual stress (RS) which, if unknown, leads to undesirable "overdesign". On the other hand, the processing parameters (laser power, geometry and passing speed) during manufacturing have a profound effect on the resulting microstructure and the RS. Therefore, there is a need to establish relationships between processing conditions and mechanical properties to deliver guidance for engineers when estimating the service life against stress corrosion cracking and fatigue in AM components.

The student will predict thermal history and stress history at the component level as well as at the microscale level using user material subroutines (UMAT) to model the crystal plasticity. The stress predictions will be validated against experimental techniques such as neutron diffraction. This would allow validation of the finite element models implemented in ABAQUS software. The student will use a number of already developed multiscale modelling techniques to predict and validate the resulting microstructure from manufacturing and to estimate the stresses at the grain boundaries using user element subroutines (UEL) and post-processing tools.

Applicant and funding:

We are looking for a self-motivated individual with skills and/or interest in solid mechanics, physics, mathematics, materials and computer programming (Fortran, Python etc). Knowledge in finite element modelling would be an advantage but is not essential.

Due to funding restrictions this position is only available for UK or European Union candidates. Funding covers tuition fees and tax-free annual maintenance payments of at least the UK Research Council minimum (currently £14,777) plus a top-up of £3,500 per annum for up to 4 years. The position is available for a start preferably in October 2018.

Informal enquiries can be made to Dr. Gonzalez (D.GonzalezRodriguez@bham.ac.uk) or to Professor Jeffery Brooks (J.Brooks@bham.ac.uk)

About PRISM2 research group:

PRISM2 at University of Birmingham is led by Professor Jeffrey Brooks and Dr. Hector Basoalto and consists of around 20 members between research fellows and PhD students working on a range of modelling projects. The group focuses on the simulation of the mechanical behaviour of materials at different length scales. In the recent years, PRISM2 group has been successful in securing funding from EPSRC, EU, IUK and industrial partners in excess of £8M. The group works very closely with industrial partners such as Rolls-Royce, TIMET and MTC, as well as partners in the nuclear sector including EDF Energy, AREVA NP, EPRI and AB Sandvik. More information about the group can be found at https://www.prism2.org/