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**CDT-ACM PhD Project 2019**

**Project Title: Hydrogen Embrittlement in 3D printed Inconel 718 superalloy**

**Project Supervisors:**

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**Short description**

Additive manufacturing (AM) via 3D-printing materials layer upon layer is an innovative manufacture method to make customised parts directly from a computer-aided design model without need of tooling and post machining. AM offers tremendous flexibility and freedom in designing and making parts. However, to unlock the full potential of additive manufacturing, many associated challenges need to be solved. One of the most significant challenges is to ensure the in-service performance of AM parts, in particular when AM materials are exposed to hydrogen. It is clear that this challenge can only be addressed if the links between process, microstructure and properties are established. Therefore, we propose to use various print parameters to fabricate a matrix of samples of Inconel 718 Nickel superalloy. X-ray diffraction, in-situ imaging (at UCL) and electron microscopy (including SEM, EBSD, HR-TEM and elemental mapping at ICL) will be performed to study the laser-matter interaction and the microstructure formation in AM of this alloy. Subsequently, as-printed samples will be exposed to hydrogen over different periods of time. Mechanical testing will be carried out to understand the deformation behaviour of AM Inconel 718 with and without being exposed to hydrogen. Diffraction, microscopic and imaging characterisation techniques as listed to the above are the key to reveal the underlying mechanisms that are responsible for the hydrogen embrittlement behaviour of printed parts. The obtained knowledge will ultimately be used to provide feedback to build processes to make reliably high quality parts. The student who is involved in this project will have numerous opportunities in learning advanced process and materials characterisation techniques such as 3d printing, x-ray diffraction/imaging, electron microscopy and mechanical testings, and obtaining in-depth knowledge of microstructure and mechanical performance of alloys.