The Future Metrology Hub

EPSRC
Engineering and Physical Sciences Research Council

Fully Funded EPSRC PhD Case studentship.

Project Title: Development of Bio functionalized surfaces using Additive Printing of Materials

The project seeks to demonstrate the capability of surface engineered metal additive bio active surfaces using Titanium as a base material. The layer-by-layer approach offered by additive manufacturing (AM) allows for the creation of complex geometries, reducing the need for assembly and increasing design freedom. Common AM techniques for the production of metal additive manufactured parts often use titanium as the powder material. Titanium has proven bio-inertness when placed in the body and is used in a variety of implant situations from knee joints to cranial reconstruction. For applications it is critical that natural tissue adheres to the implants to facilitate osseo-integration whilst not encouraging biofilm formation and onset of infection.

The majority of implant failures due to loosening occur in the first 12 months post-implantation so it is critical to maximize attachment in the initial phase immediately post-implantation.

There has been a recent focus on the bulk properties and post processing of additive manufactured components. This project seeks to develop specific surface treatments and topographies to be used on patient specific titanium implants. The project will investigate the specific interplay between accelerated tissue/bone integration and biofilm formation and infection, the so called 'race to the surface'.

The project will investigate multi-scale surface structures through manufacture of implant relevant coupon geometries and surfaces to ascertain the efficacy of bone-cell attachment in vitro.

Coupons will be additively manufactured using Ti6Al4V orthopaedic grade material finished to implant relevant surface topography, further samples will be coated with a layer of hydroxyapatite.

It has been shown in previous studies that a pore size of <1200 um inhibits integration in bone scaffolds. Three basic cell structures will be investigated initially. The first two will be based on regular geometries that are used in other applications (hexagonal, cubic) and the third will be a developed stochastic trabecular-mimic structure designed using the Poisson-disk method.

Model cells will be utilized to measure attachment.

Multi-scale characterization will be performed both to determine the form and reliability of the manufactured cell structure but also the presence and adherence of cells post-culture using the following equipment:

- Industrial CT scanner
- Alicona infinite focus confocal microscope
- Zeiss SEM/Imaging Suite including fluorescence microscopy

University of Huddersfield | The University Of Sheffield. | Loughborough University | University of Bath

This project will form part of a larger scale collaboration with Zimmer Biomet who will provide material support to the project and a possible route to early impact.

Eligibility: Prospective candidates should have a minimum of a Bachelors level degree in mechanical/production engineering or materials science at a 1st or 2:1 level.

Salary: £15,609 (2021/22 EPSRC Standard)

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