The University of Queensland - IIT Delhi Academy of Research Joint PhD Project

PROJECT TITLE	**SURFACE MODIFICATION OF BIODEGRADABLE SCAFFOLDS FOR BONE TISSUE ENGINEERING APPLICATION**
PROJECT CODE	**UQIDAR 00216**
PROJECT DESCRIPTION	Modified polymer surfaces are gaining huge significance in various fields with wide applications in the biomedical industry. The surface modification on polymers can be achieved by various methods like exuberant physical method, self-organization and self-assembly and chemical functionalization of the polymeric surface. Among all the methods self-organization and self-assembly at the molecular level inspired by the biological moieties like protein, DNA is considered as the forerunner because of its low cost and easily approachable techniques. Thin-film dewetting leading to the formation of self-assembled arrays of polymer droplets creates a modified surface over which the scaffolding can be carried out. This regular arrangement of polymer droplets is utilized as a template for self-arrangement of nanoparticles over this surface creating a surface with higher functionalities. The underlying dewetting stress, engineers the nanoparticles to self-assemble among themselves and form different morphologies adding an edge to the already modified surface. The biocompatible polymer blends can create a membrane-like porous surface which is mechanically strong and the addition of nanoparticles increases the surface functionalities and act as a bio-scaffold. Theoretical analysis will also be carried to understand the physics and the phenomenon of formation of the structures and morphologies. Successful TE approaches will be best achieved when the biomaterial scaffold has mechanical properties, surface chemistries, and structural mechanics that are compatible with that of bones and allow osteointegration and subsequent replacement by native tissues. In the proposed project, the biodegradable polymer will be used for making scaffolds using selective laser sintering (SLS) processes. SLS will be carried out to investigate the effects of processing parameters on the microstructure, mechanical properties, and geometrical accuracy of the scaffolds.
PROJECT OUTCOMES	- Design a biocompatible and biodegradable blend and construct a porous membrane with required mechanical properties and modify the surface functionality with nanoparticles. - Generate an array of polymeric droplets over a substrate and then functionalize the arrays with nanoparticles and create a 3D scaffold. - Self-assembly of the nanoparticles over the engineered surface constructing a membrane-like structure - A theoretical study by continuum mechanics, FEA and CFD - Understand the effect of SLS process parameters on the microstructure evolution, mechanical properties, and geometric accuracy of the scaffold; - Optimize the SLS process to achieve scaffolds with the adequate load-bearing capability and optimal internal architecture for TE application; and - Evaluate the biocompatibility and osteointegration properties of the scaffolds.
ADVISORY TEAM	**Dr Mingyuan Lu** Mechanical and Mining Engineering, UQ https://researchers.uq.edu.au/researcher/12274 **Associate Professor Jayati Sarkar** Chemical Engineering, IITD http://web.iitd.ac.in/~jayati/

TYPE OF STUDENT	Applications are open to **i or q student**s who meet eligibility criteria. *note: i-students must have own scholarship to apply (CSIR, UCG-NET, etc.)*
DISCIPLINE BACKGROUND OF STUDENT	Ideally, this project requires students with a background in: materials science/mechanical engineering/biomedical engineering/chemistry (a multidisciplinary project, the student needs to learn other things)
IDEAL CANDIDATE	Essential capabilities:characterization of material properties Desirable capabilities:FEA or CFD simulation Expected qualifications (courses, degrees, etc): B.Tech/M.Tech in materials science/mechanical engineering/biomedical engineering/chemistry
APPLICATION PROCESS	Apply online by the due date: https://www.uqidar.org/students/how-to-apply/