Masters opportunity in Materials Science

Commencing WiSe 2019 or SoSe 2020

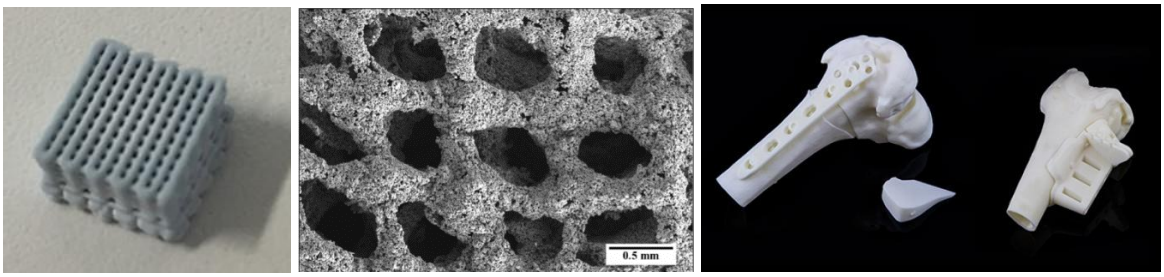
Optimisation of additive manufacturing processes for nanocrystalline sorosilicate, orthosilicate and pyroxene bioceramics.

Background: Additively manufactured bioceramics have been drawing much research attention in recent years towards the development of patient-tailored implants. Finding printable materials that exhibit favourable bioactivity and fracture toughness is a key objective of such research efforts.

Bioactive ceramics are those that are conducive to bone intergrowth through the formation of a precipitated calcium-phosphorus layer. While bioceramics are often amorphous, crystalline materials are increasingly being investigated towards the development of bioactive materials with improved fracture toughness relative to glasses. Of particular interest is the ability to tune the chemical and physical properties of such systems through substitution of metal cations and control of morphology.

Silicate ceramics are defined by various arrangements of SiO_4 tetrahedra interspersed with larger metal cation sites. Crystalline silicates of orthosilicate, sorosilicate and pyroxene families are distinguished by having isolated, paired and chain arrangements of SiO_4 units respectively.

Project: The systems we will investigate in this project here include Orthosilicates $(Zn,Mg)_2SiO_4$, Sorosilicates $Ca_2(Mg,Zn)Si_2O_7$ and pyroxenes $Ca(Mg,Zn)Si_2O_6$. Materials will be prepared by a simple precipitation method followed by calcination. Slurry optimisation in terms of rheology and solids loadings will be conducted towards the fabrication of woodpile structures by a robo-casting method developed here. Materials will be characterised in terms of bioactivity in simulated body fluid (SBF) and compressive strength. This project offers a suitable candidate an opportunity to gain multi-faceted experience in the field of applied materials science and engineering.



Figures of 3D printed bioceramics, microstructure and a represenatative implant

Contact:

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