DESIGN AND FABRICATION OF AN ARTIFICIAL BONE SCAFFOLD

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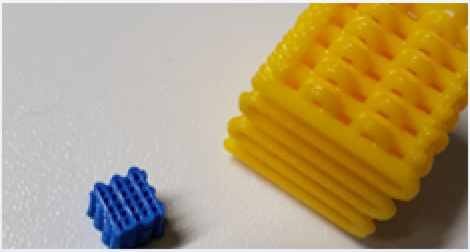
ABSTRACT



Bone fracture is a widespread injury associated with individual disability and loss of social productivity resulting in very high treatment costs. Well-designed scaffold implants are good alternatives in bone tissue engineering known to result in effective healing.

Aim of this study is to develop an effective solid free-form fabrication (SFF) based technique capable of printing composites with well controlled macro-micro porosities making primarily use of commercial 3D printers.

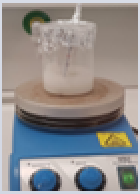
OBJECTIVES

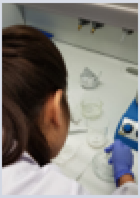
→To find more economic methods for bone healing process.

→To understand healing process both ***biologically*** and ***mechanically***

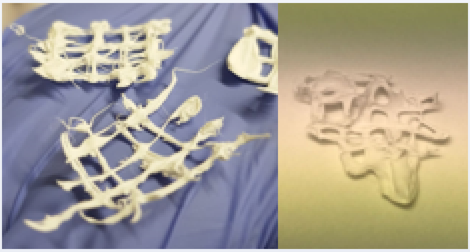
→To ***design and produce artificial bone scaffold*** for personal treatment and different situations.

PROJECT DETAILS





Computational topology design and SFF efforts made it possible to create scaffolds with controlled architecture. The level-set based approach unlike existing standard topology optimization methods can overcome issues such as high computational demand and local minima problems



.Here we develop a computational design tool based on the integration of the level set method and mechano-regulatory models for optimizing scaffolds topologically based on desired multi-functionality including elasticity, diffusivity, and permeability as well as biological functionality

Poly(ε-caprolactone) (PCL) was chosen as the scaffold polymer, which is FDA approved. Recently, non-solvent-induced phase separation (NIPS) seems capable of producing these scaffolds with multi-scale porosity if integrated into the 3D printing based process. Using this method, here we develop scaffolds with multi-scale porosity (< 10μm and >100 μm) where, PCL pellets are dissolved in the THF solvent and mixed with various amounts of HA powders.

CONCLUSIONS

We have printed multiple prototypes with different parameters and tried to determine the best result.

After that we tried to improve our main material with NIPS method which is more compatible for the bone structures.

From now on, this project aims to optimizes the printing part of the scaffolds and the material for the porosity, strength, pressure and angiogenesis(the development of new blood vessels)

REFERENCES

- Hollister, S. J., Nature Materials, 2003; Aslan, O. S. and Kiziltas, G., Proc. Of TERMIS-EU, 2013
- Kim, J., Shin, K., Koh, Y., Hah, M. J., Moon, J., & Kim, H. (2017). Production of Poly(ε-Caprolactone)/Hydroxyapatite Composite Scaffolds with a Tailored Macro/Micro-Porous Structure, High Mechanical Properties, and Excellent Bioactivity. *Materials*, *10*(10).