Abstract ID-188

NUMERICAL AND EXPERIMENTAL CHARACTERIZATION OF TPMS BASED SCAFFOLDS

Júlia Pinheiro[1], Rui Ruben[2], A. P. G. Castro[3], José Miranda Guedes[1], Paulo Fernandes[1]

[1]**Universidade de Lisboa, Portugal**
jp_juliapinheiro@hotmail.com, jmguedes@tecnico.ulisboa.pt, paulo.rui.fernandes@tecnico.ulisboa.pt

[2]**ESFG, CDRSP, Instituto Politécnico de Leiria, Portugal**
rui.ruben@ipleiria.pt

[3]**IDMEC, Instituto Superior Técnico, University of Lisboa, Portugal**
andre.castro@tecnico.ulisboa.pt

Keywords: Scaffolds, Tissue Engineering, Triply Periodic Minimal Surfaces

Summary: Scaffolds are porous fabricated structures made for a specific cellular growth. The biological cell needs for a correct cell proliferation and differentiation require a structure with proper characteristics to permit diffusion of oxygen, nutrients and metabolic waste. In addition, applications such bone tissue engineering require scaffolds with enough structural integrity to maintain the bone shape and function. So, scaffolds must present right values for porosity, permeability and mechanical properties to satisfy these requisites. There are different design and manufacturing approaches to control the scaffold microstructure in order to obtain the right properties. The use of computer-aided tools followed by additive manufacturing is a promising approach.
Lately, geometries obtained using triply periodic minimal surfaces (TPMS) have been used to computationally design the porous scaffolds. TPMS have the advantage of obtaining an interconnected structure by controlling the porosity. However, the actual permeability of the structure as well as the stiffness is not directly controlled. Moreover, the fabrication process has to assure that the properties assessed theoretical are verified in the obtained scaffolds.
Thus, in this work the objective is to assess the properties of TPMS obtained using Schwartz P, Schwartz D, Gyroid and P W Hybrid surfaces. These properties are computed by the asymptotic homogenization method to obtain the effective permeability and stiffness. Different porosities were tested for each surface type and an analysis was also done in order to evaluate the influence of the unit cell dimensions on the mechanical properties of the scaffolds.
The computed structures were fabricated using a MultiJet 3D printer. The resulting scaffolds were scanned using microCT in order to geometrically compare the obtained microstructure with the designed one.
Results show that the obtained properties compare well with the properties of bone scaffolds presented in literature and obtained using different means. From the geometrical analysis, we observe that the fabricated structures reproduce well the designed feature of the microstructure.