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ε-policaprolactone as Biomaterial for 3D Scaffold Produced by Rapid Prototyping

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Abstract – Tissue engineering combines principles of life sciences and engineering to replace and repair damaged human tissue. Present practice generally requires the use of porous, bioresorbable scaffolds to serve as temporary 3D templates to guide cell attachment, differentiation, proliferation, and subsequent regenerate tissue formation [1]. The thermal study is one of the characterizations necessary for the production of 3D scaffolds using ε-policaprolactone (ε-PCL) as biomaterial in an Extrusion Rapid Prototyping Process. To characterize this material, a Mettler Toledo DSC 823e calorimeter will be used for thermal dynamic analysis. With these results we can understand how the polymer thermally behaves for a better use as biomaterial for prototyping on SLS and Fab@Home. Cells will be cultured and a construct will be produced

Tissue engineering has been a great focus of research in the last years. These studies involve a multidisciplinary field of research including among many areas, biologists, material and chemical engineers, and clinics. The main idea is to produce biological substitutes to replace damaged or missing organs or tissues. Therefore, it is necessary a tight integration of biomaterials, cells, differentiation factors, and sometimes a place to mature the substitute like bioreactors [2].

On the other hand, a new class of technologies called rapid prototyping or additive fabrication is available commercially and being developed as researches for engineers applications. This class of technology is based on the paradigm of material deposition layer-by-layer to create parts with any complex geometry via Computer Aided Design (CAD). Then, it seems to be natural to use this paradigm to produce scaffolds with anatomical geometries and controlled pores in terms of size [3].

Among biomaterials, ε-PCL, aliphatic polyester, is an interesting one for 3D scaffold prototyping for the reason that is commercially used, can be easily processed and is biocompatible. This work proposes the characterization of ε-PCL as an adequate biomaterial to use in the rapid prototyping processes to produce 3D scaffolds. The thermal analyses will be performed at Mettler Toledo DSC 823e calorimeter. The ε-PCL (Solvay CAPA® 6505) sample mass will be from 5 to 10 mg. 3 following dynamic analysis will be done: 25℃ to 110℃, 110℃ to -50℃ and -50℃ to 210℃ at 10℃ /min Heating Rate. The scaffold porosity will be controlled at SLS (Selective Laser Sintering) and Fab@Home (Experimental platform) (Fig.1), and cells will be cultured for a posterior addition to the scaffold, building a construct.

Scaffolds are anticipated to play an important role in allowing physicians to simultaneously reconstruct and regenerate damaged human tissue such as bone, cartilage, ligament and tendon [1].

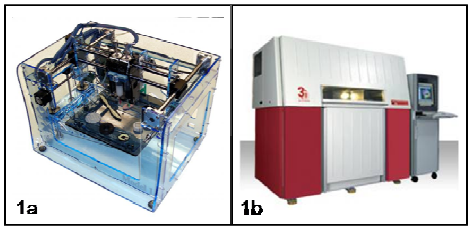

Figure 1: Plotting system scheme by means of material deposition layer by layer. a) Fab@Home Model 1. b) SLS® System.

References

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