Additive Manufacturing of PLA-based composites using a colloidal feedstock: biodegradable scaffolds for odontology applications

A.J. Sanchez-Herencia
A. Ferrandez-Montero, A. Eguiluz, Z. Gonzalez, B. Ferrari

Institute of Ceramic and Glass, CSIC, Madrid, Spain.

Contact: bferrari@icv.csic.es

Abstract

Thermal extrusion of materials, commonly known fused filament forming (FFF), is one of the most extended additive manufacturing technique, since it is easy to settle, safe, and inexpensive. The use of FFF to fabricate composite scaffolds require of a filament composed by the metal/ceramic load and a thermoplastic polymer, which provide enough fluidity to the mixture to be shaped. In this sense, polymers such as PLA or PCL act as structurers of the final shape and printing vehicle, being the dispersion of the metal/ceramic phase in the polymer matrix a key condition to provide the biofunctionality.

A colloidal approach will be described to process PLA-based filaments with different compositions, ranging from 5 to 50 vol.% solid content of homogeneously dispersed metal/ceramic powder (Ti, Mg or HA). Inorganic particles were stabilized to be compatible with the PLA matrix during printing, while dispersion allows including enough inorganic load in the filament to shape a 100% inorganic implant after the ad hoc thermal treatment. Thermal behaviour of this colloidal feedstock was mainly studied in terms of rheological measurements, while different powders (in nature and size) were used to formulate available PLA composites to be printed. The filament was used to shape different pieces using a 3D desktop printer, and some of them were thermally treated to finally produce inorganic scaffolds. Cellular adhesion and proliferation tests were carried out to evidence no cytotoxicity and favourable characteristics of PLA-based composites surfaces.

References

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Figure

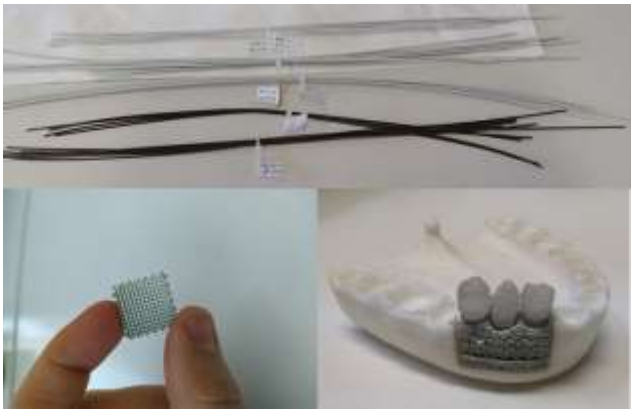

Figure 1: Picture PLA-based filaments and scaffolds prepared by FFF