3D printed Ti(C,N)- nano nickel composites by FFF of a colloidal Feedstock

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Among cold AM techniques (with printing temperatures lower than 300ºC), Fused Filament Fabrication (FFF) is arising as appropriated approach for the quick fabrication of customized 3D pieces with complex structures and geometries. This technique avoid the thermal shock defects generated for the energized techniques such as the Selective laser sintering (SLS) or Focused ion beam (FIB). Fabrication of dense parts using FFF requires the processing of a thermoplastic-based filament with a high content of solids, where the inorganic phase is highly dispersed to ensure the flowability during the filament fusion and an elevated green density.

Titanium carbonitride Ti(C,N) is a non-oxide ceramic with strength and chemical resistance that allows a high performance in aggressive situations. To reach complex pieces by FFF with the same properties is necessary high density after sintering stage. Without pressure Ti (C, N) by itself is not able to sinter up to full density, reason because sintering aids are needed.

The aim of this work is to process filaments with high solid loadings of Ti (C,N) and nanonickel as a sintering aid. Controlling the colloidal interactions the nanosized particles are well dispersed onto the surface of the macrosized ceramic particles to achieve an adequate effect. Additionally, the colloidal approach enhances the dispersion of the two inorganic phases in the polymer matrix in order to achieve the required high solid contents of the composite feedstock. Colloidal processing variables, such as dispersant content or viscosity, play an important role in the thermoplastic behaviour of the feedstock as well as in the inorganic phase dispersion. The composite feedstock is studied by melting rheology as a function of the thermoplastics agent- PLA (Polylactic acid) and PEG (Polyethylenglicol) - . After extrude a filament with a high homogeneity using the feedstock processed pieces are shaped by FFF and thermally treated with a presureless sintering to finally achieve full ceramic pieces.

Figures

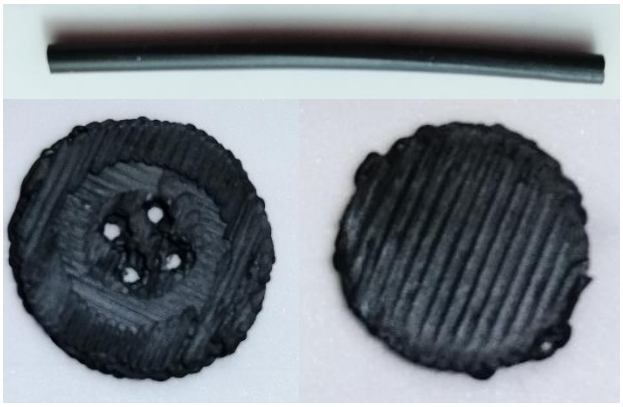

Figure 1: Filament and green pieces of Ti (C, N) with diferent shapes.

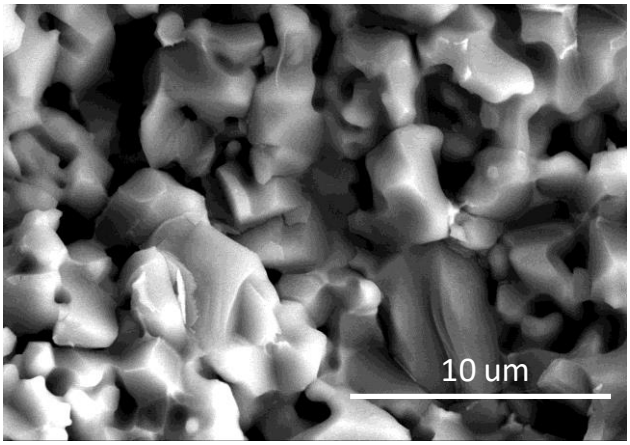

Figure 2: Micrograph of the Ti (C, N)-nNi structrure after presureless sintering.