3DCERAM Introduces a New Pellet Head for 3D-Printing of Ceramic and Metal Feedstock

Are you working in injection molding and looking for a cost-effective solution for prototyping prior to tool manufacturing? Are you in search of way to debind your 3D-printed parts in water instead of acetone or alcohol? Would you like to reduce the amount of waste you create with prototyping by recycling some of the "failed" parts?

Fig. 1
Printed nozzle

If these are the questions you are seeking answers to then, it might just be worth investing some time to read this article.
3DCERAM introduces its new direct pellet extrusion head (from henceforth referred to as pellet head) on its M.A.T. (Multi Additive Technology) machine for prototyping of technical ceramics and metals. The pellet head, as the name suggests, works directly with injection molding pellets or granulates. The 3D-printing of pellets offers several advantages like material-cost saving, water debinding, recyclability, among others and have been summarized below:

Keywords
ceramic and metal feedstocks

Cost efficient prototyping with pellets and M.A.T.
The use of pellets manufactured for injection molding for 3D-printing can help significantly reduce the cost of prototyping. Injection molding pellets due to their large-scale manufacturing can cost as much as an order of magnitude less compared to ceramic and metal filaments for 3D-printing. Filaments tend to have higher price not only because of the lower demand – since the FFF technology is relatively new – but also since the process necessitates an extra manufacturing step i.e. filament extrusion – which needs to be highly stable due to filament tolerance requirements of 1,75/2,85 mm +/- 0,05 mm.
In case of custom-developed feedstocks for 3D-printing, again the cost of feedstock development tends to be lower than of filaments, as one needs to tailor only certain critical parameters like viscosity, flowability, for the printing process, but for filaments all these parameters need to be respected in addition to a good filament flexibility that allows easy handling, spooling and printing. This results in a longer development cycle for filaments as compared to feedstocks.
Note: It is worth noting that although there is strong argument in terms of price for pellets, 3d-printing with filament does still yield parts that have superior surface finish and which has a better resolution as compared to direct pellet 3D-printing (summarized once again later).

Case study nozzle
The M.A.T. machines capability to host a CNC milling tool in addition to a pellet head for green machining improves surface finish of the parts – which can have a significant influence on the mechanical characteristics of the manufactured part. The added freedom of this green machining on the same machine eliminates the need for clamps and fixtures, and reduces the cost and time normally associated with hard machining of sintered parts. The green machining can be done after printing or can be done simultaneously with printing (printing

Tab. 1 Parameters for case study

Material	Aluminum Oxide
Size [mm]	110 x 110 x 150
Weight [g]	125
Material cost [EUR]	~ 6
Printing time [min]	45
Nozzle size [mm]	0,8
Layer height [mm]	0,4

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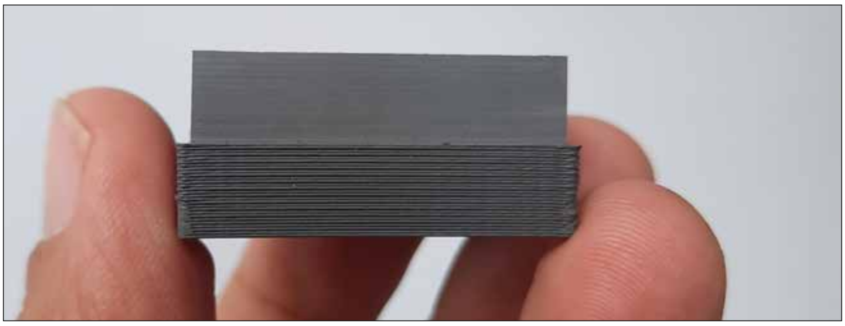

Fig. 2
Example of 3D-printed and green-machined SiC part (top green machined, bottom as printed)

5 layers and machining, and then printing again).

Water debinding

Most filaments for the 3D-printing of technical ceramics and metals necessitate a solvent debinding step in acetone to dissolve the softener in the filament binder. While this is a simple and straightforward process for those already working with acetone debinding (commonly used in CIM/MIM), the solvent debinding in acetone can be slightly repulsive to those afraid of its flammable nature. Here again printing with pellets can offer you some advantages. When working with pellets with certain binder systems (for example with PEG as one of its components), the solvent debinding step can be simply carried out in water at room temperature. Just leave your printed parts in water bath at room temperature over the weekend and your parts should already be debound by monday. And it gets better, the water is not toxic and can be simply discarded without any special care or recycling needs.

One might wonder "why don't we use the same kind of binders for filaments?" Well, water-soluble binder-systems generally tend to be very brittle, so when you extrude them, they tend to break just after few meters making the spooling of such filaments

Fig. 3 a–d
Parts with SiC feedstock (water soluble; top a, b),
parts with alumina feedstock (acetone soluble; bottom c, d)

almost impossible for filament manufacturing. 3DCERAM's current portfolio of ceramic filaments offered with the M.A.T. are flexible but they are not based on water-soluble binders and require solvent debinding in acetone.

Material recycling

Prototyping normally involves a lot of trial and error until you finally get the right shaping parameters which yield the right part. This means that the first or the second (or even the tenth print) is a "fail" print. This process generates a lot of waste, which again pellet printing has a good solution to. When your part does fail, just crush it and reuse it. This further sinks the cost of prototyping further as you only need to work with a small amount of material.

About 3DCERAM M.A.T.

With the introduction of the pellet head, 3DCERAM's M.A.T. machine has become

Fig. 4
M.A.T. machine