316 L Steel MIM-like 3D Printing

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Additive manufacturing is known for rapid prototyping and enabling the realization of complex geometry that would not be achievable through conventional techniques. Regarding metallic materials, fabrication is usually performed by complicated and expensive methods such as Binder Jetting[1] or Powder Bed Selective Laser-based processes[2]. These solutions require extensive control of the printing environment and can restrict the design especially for hollow shapes.

On the other hand, more affordable solutions have been developed to facilitate the shaping process by using polymer binder extrusion in Fused Deposition Modeling (FDM). This method, produces a green part composed of powders of the target material encapsulated in a polymer binding matrix that will later be removed. The part is finally solidified in a sintering furnace. In some recent works[3], [4], the feedstock for the printing step has been put into a filament form to be used with classical cheap 3D printers. However, this requires a preliminary and technically difficult step and reduces the availability of various metal for 3D printing.

In this work, we propose an FDM additive manufacturing process that uses a feedstock in the form of small pellets composed of a similar mix of 316L Stainless Steel powder bound by a thermoplastic polymer. The printing stage is performed using an affordable Archimedes screw system that is mounted on a classical 3-axis cinematic frame. The feedstock, provided by PolyMIM, is diverted from its original use, which is Metal Injection Moulding (MIM), and is intended to be debinded and sintered. This allows to consider a wide range of materials already available. The impact of the deposition strategy on the tensile properties will be investigated in relation with the microstructure.

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