Characterization of 17-4PH stainless steel processed by a solid-state additive manufacturing technology

Additive manufacturing of metals and alloys has become a quite consolidated reality in industrial processes for demanding applications which require high level of customization and remarkable geometrical complexity. Powder bed fusion (PBF) and directed energy deposition (DED), as defined by the ASTMF42 and ISOTC261 regulation committees, are the most widely spread processes to fabricate metallic objects in a layer-by-layer fashion, following the principles of Design for Additive Manufacturing (DfAM), which leverage their implementation. However, together with these fusion-based metal additive manufacturing technologies other solid-state processes are arising, including mechanical deformation-based and sintering-based ones. The latter are aligned with conventional fabrication techniques, such as metal injection molding (MIM), and take advantage of the freeform fabrication of the initial green part. One of the latest additions to the sintering-based metal AM category is Bound Metal Deposition (BMD), a material extrusion process provided by the Desktop Metal Studio System equipment, characterized by three fabrication steps (3D printing, debinding, and sintering) and by unique polymer-based composite rods as extrusion feedstock.

With the goal of providing a complete overview of BMD solid-state AM technology, 17-4PH stainless steel-based rods were used to fabricate samples with two different infill deposition strategies. A wide range of characterization techniques allowed showing how the feedstock- and process-related defects can play a major role in defining the final microstructure of the samples and their mechanical properties.