

Impact of Sinter-Based Metal Additive Manufacturing on Metal Injection Molding

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Abstract

The emergence of Sinter-based metal Additive Manufacturing (AM) technologies is expected to spur an unprecedented growth in the area of metal AM. Sinter-based processes offer significant advantages over melt-based metal AM technologies. Similar to metal injection molding (MIM), Bound Metal Disposition (BMD) is based on the material extrusion process like Fused Filament Fabrication (FFF) and is meant for rapid prototyping and low volume serial production, while the binder jetting process addresses high- and medium-volume production of metal parts. Both have the advantage of freeform fabrication of metal parts without any tooling, and are expected to have a significant impact on MIM technology in different ways. This paper will discuss the two Sinter-based AM platforms and explore their impact on MIM technology.

Introduction

The 1990s witnessed the introduction of rapid prototyping (RP) which is a form of 3D printing technology. Rapid prototyping is primarily used for creating rapid tooling and small number of prototype parts for testing the form, fit and function of a metallic part in an application. Though polymer-based 3D printing led the way, metal 3D printing in the form of laser-based and e-beam melting based techniques started to slowly emerge. However, RP technology was mainly used for one-off parts, the technology of 3D printing did not gain prominence in the manufacturing arena until the turn of the millennium. However, even during the early 2000s, most metal 3D AM technologies did not have any major bearing on the well-established technology of MIM.

The last two decades witnessed the emergence of sinter-based metal AM technologies primarily led by the two popular technologies based on material extrusion or FFF technology, and the other based on binder jetting. Between the two technologies, the first, based on FFF, is a rapid prototyping and low volume serial production technique, while the binder jet technology is primarily meant to address the medium to high volume production of metal components. FFF processes based on material extrusion technology can be complimentary to MIM, while binder jet technology can be competitive to MIM. A schematic of the MIM, BMD, and binder jet processing steps are shown in Figure 1. Figure 2 shows the relative positions of the multitude of metal shaping processes that are currently in use excluding all the sinter-based AM processes that are based on a separate step for geometric shaping and a separate step