Evaluation of AM Technologies in MIM Applications: Part 1.

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ABSTRACT

Metal Additive Manufacturing (AM) utilizes metal powder to produce parts making it part of the PM (Powder Metallurgy) group of technologies. In addition to its ability to create unique geometrical attributes not attainable by other manufacturing technologies, Metal AM offers a different economy of scale because it is capable of producing parts at production volumes far lower than what is economically viable with Metal Injection Molding (MIM). However, Metal AM parts will have differences from similar MIM parts, for instance in their surface finish and tolerances.

Recent developments in AM include technologies that produce a part that is metal powder bound together with an organic: Binder Jetting, Material Extrusion, Material Jetting, and Vat Photopolymerization of metal-loaded photopolymers. This composite part is subsequently debound and sintered to create the solid part, making these technologies very similar to MIM. For the purpose of this paper, this collection of technologies will be referred to as "Non-Fusion Metal AM". These new AM technologies are of interest to MIM companies as they leverage much of the knowledge base of MIM and, in some cases, use similar powders and sintering conditions. These AM technologies have the potential to enable the production of MIM-like parts at production volumes not economically viable by using MIM.

This paper will review the typical attainable attributes of the MIM process and compare them to the attributes and capabilities reported by these new AM technologies. A proof-of-concept part design will be submitted to the AM sources to get feedback and cost data.

INTRODUCTION

MIM Process Description

In the late 1970's, MIM emerged as viable manufacturing technology for small, complex parts requiring high-temperature alloys. Figure 1 shows the fundamental process used by most practitioners. The following are comments on a few aspects of the MIM process: