METALLOGRAPHIC CHARACTERIZATION OF POROUS LOW ALLOY STEEL SAMPLES MANUFACTURED USING BOTH PRESS-AND-SINTER AND ADDITIVE MANUFACTURING TECHNIQUES

Thomas F. Murphy, Christopher T. Schade, and Kerri M. Horvay
Hoeganaes Corporation
Cinnaminson, NJ

ABSTRACT

The ability to use Additive Manufacturing (AM) techniques with more traditional feedstock alloys to build porous prototype structural and automotive parts recently has grown in importance. The feasibility of producing these AM parts as performance predictors of their Powder Metallurgy (PM) counterparts is dependent on their final microstructure and pore structure. In this manuscript, both the AM and target PM components are evaluated using metallographic techniques on examples manufactured from water atomized FL-4600 grade low alloy steel powders. Light optical and scanning electron microscopy are used to analyze the microstructures and pore structures, while fracture surfaces are evaluated using scanning electron microscopy. In addition, automated image analysis techniques are incorporated into the light optical microscopy investigation for quantification of the pore structure in the as-created states from both the AM and PM processes.

INTRODUCTION

Designing PM parts and the production sequence used to make them requires the creation of prototype parts intended to validate their design, the materials used, and their performance through laboratory and field testing. During the initial stages of prototype part manufacture, frequently compaction tooling (dies and punches) must be made to produce parts for initial testing of the PM part design. This can be both expensive and time consuming. To avoid these cost and time issues, additive manufacturing methods can be used to make the pre-PM process parts, thus bypassing the need for pre-production die and tool sets. Another benefit of the AM process is sometimes the speed with which the prototype parts can be made compared with developing and implementing the specific PM process. In addition, the ability to produce size and shape details accurately may help to minimize the secondary machining operations required for the PM parts, which may also shorten the qualification time from prototype to manufacturing.