FINE POWDER TECHNOLOGIES

Introduction

The use of metal powders have continuously developed since several years in many industries, and in particular in medical applications such as implants.

Indeed, powder metallurgy technologies offer two main benefits:

- The possibility to produce Near net shape or Net shape components, thus reducing the need for machining or finishing operations.
- A unique and fine microstructure thanks to the rapid solidification of metal powders, which helps improving significantly material properties such as strength and reliability.

Among powder technologies used in medical implant applications, Additive Manufacturing, Metal Injection Moulding (MIM) and Hot Isostatic Pressing (HIP) are complementary options depending on the number of parts to be produced and part weight.

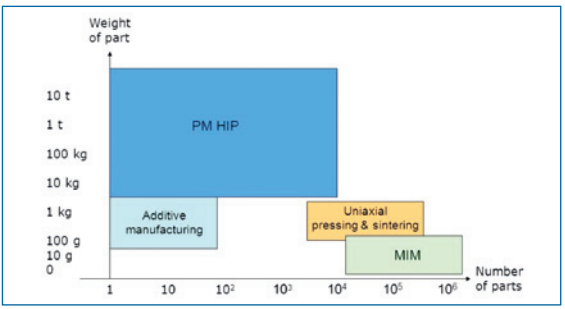

FIGURE 1: Positiong of HIP, Additive Manufacturing and MIM technologies depending on series and part weight

Powder manufacturing

Metal powders are produced by gas atomization. During the process, the molten metal is atomized through a nozzle into fine droplets, thanks to the action of high pressure inert gas jets. The fine droplets of liquid metal cool down then during their fall inside the atomization chamber. The spherical metal powder is then collected in a container before further processing and consolidation.

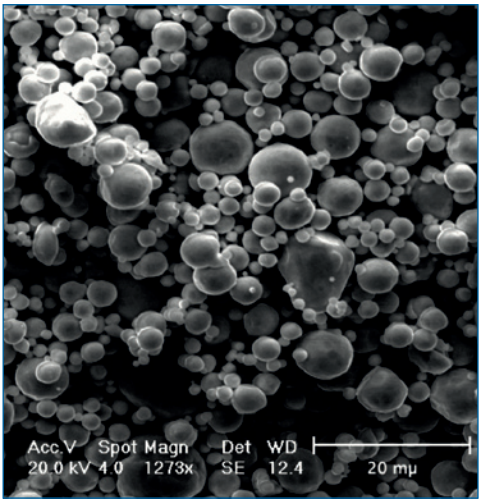

FIGURE 2: Spherical gas atomized metal powders

With a new state-of-the art VIM gas atomizer in its new production site in Spain, Erasteel manufactures fine powder suitable for Metal Injection Moulding and other applications such as Additive Manufacturing, and Laser Cladding processes. The Pearl® Micro range includes Nickel, Cobalt, Copper, Iron-base alloys and Silver alloys. Thanks to the Vacuum Induction Melting (VIM) technology, specialty alloys with additions of reactive

metals can be processed such as Titanium or Aluminum. The factory specializes in standard or tailor-made alloys, available in small batches from 5kg, very suitable for the production of small series of metal parts or Research & Development activities. Erasteel also offers a wide range of Pearl® metal powders from its production site in Sweden for the production of metal components by Hot Isostatic Pressing technology.

FIGURE 3: The VIM gas atomizer at Metallied in Irun, Spain

Additive Manufacturing

The additive layer manufacturing (ALM) process is a revolutionary manufacturing process, also known as freeform fabrication, rapid prototyping or selective laser melting. With the ALM process, solid objects can be built layer by layer, by melting fine metal powders selectively with a laser or electron beam, according to the exact geometry defined by a 3D CAD model.

Additive Manufacturing enables to produce parts with very complex geometries without tools nor wasting material. The huge design flexibility enables to create almost any part without any manufacturing constraints.

The ALM technology is used to produce dental implants with Cobalt-Chromium powders as well as Titanium alloys implants.

Metal Injection Moulding (MIM)

Metal Injection Molding (MIM) is a manufacturing process to produce complex small metal parts in large series. It starts with the mixing of fine gas-atomized powders (usually below 25 µm) with a binder into a granules named "feedstock". The feedstock is then processed in an injection molding machine, to fill in net shape molds, like in polymer injection moulding operation. After molding, the binder is removed and the MIM parts are sintered to high density and dimensional accuracy: the properties are maximized and the structure remains the same. This process enables to produce parts that whould be highly difficult to obtain otherwise.

Metal powders used in the MIM process can be stainless steels, low alloys steels, magnetic alloys, HSS, tool steels, Co-base alloys, superalloys, etc.

Hot Isostatic Pressing (HIP)

Hot Isostatic Pressing (HIP) is a process to densify powders or cast and sintered parts in a furnace at high pressure

(100-200 MPa) and at temperatures from 900 to 1250°C. for example for steels and superalloys. The gas pressure acts uniformly in all directions to provide isostropic properties and 100% densification. It provides many benefits and has become a viable and high performance alternative to conventional processes such as forging, casting and machining in many applications.

The HIP process can be used to manufacture both Near Net Shape components or semi products such as round bars that can be further forged, rolled and machined.

In the medical area, the HIP technology is used to produce hip implants with Cobalt-Chromium powders.

Partner

Erasteel is a world leading producer of high quality gas-atomized metal powders for HIP. With its new subsidiary, Metallied based in Irun, Spain, Erasteel offers a complete range of metal powders for new technologies such as additive manufacturing and MIM.

Powder technologies have a strong potential and offer many benefits. Their development is supported by intensive Research & Development activities which will benefit medical implant applications.

Produced by VIM gas atomization or high pressure water atomization, the high quality Pearl® Micro powders are available in small lots from 10 kg.

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