Using 3D Printing to obtain metal products

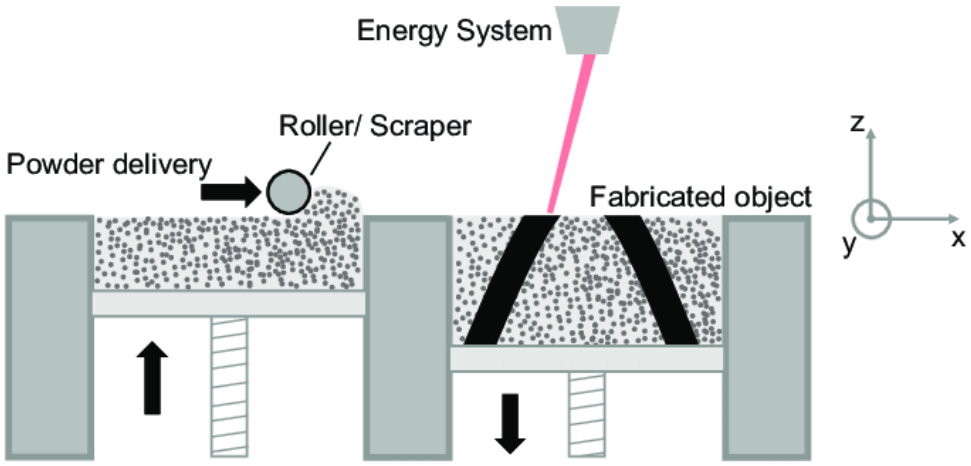
The assignable growth of 3D printing over the last decade triggered the attention of more conservative industries in these rising processes. Even though it is typically associated with polymeric components, the additive manufacturing processes had numerous advantages that had not been achieved by metallic transformation techniques. Today, the use of 3D printing techniques to produce metallic components promptly available to use is a reality.

The technologies available are inspired on the polymeric methods already developed with some minor changes. Varying on the state of the raw material and on the binding technology, all the processes presented are successfully commercialised over the world. The better-known processes are:

- Powder Bed Fusion;
- Direct Energy Deposition;
- Binder Jetting;
- Bound Powder Extrusion.

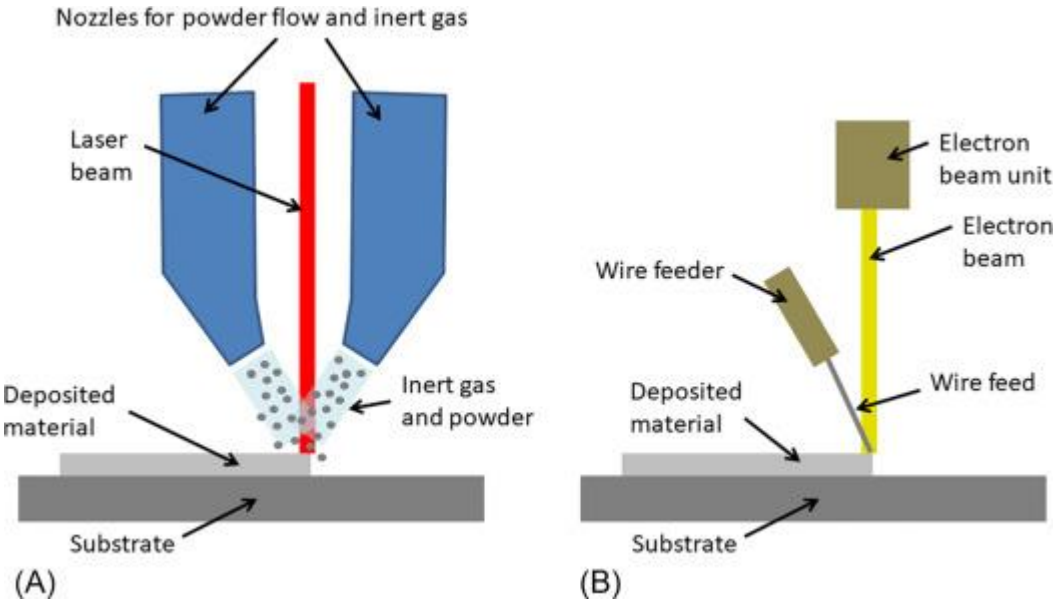
Powder Bed Fusion

The main principle of Powder Bed Fusion resides on a fine layer of powder placed over a printing area with an energy source melting selectively certain points of the powder. The energy sources may be laser beams or electron beams. This method is extremely expensive due to the great amount of raw material necessary to fill the printing cavity. Naturally, this method does not require supports.



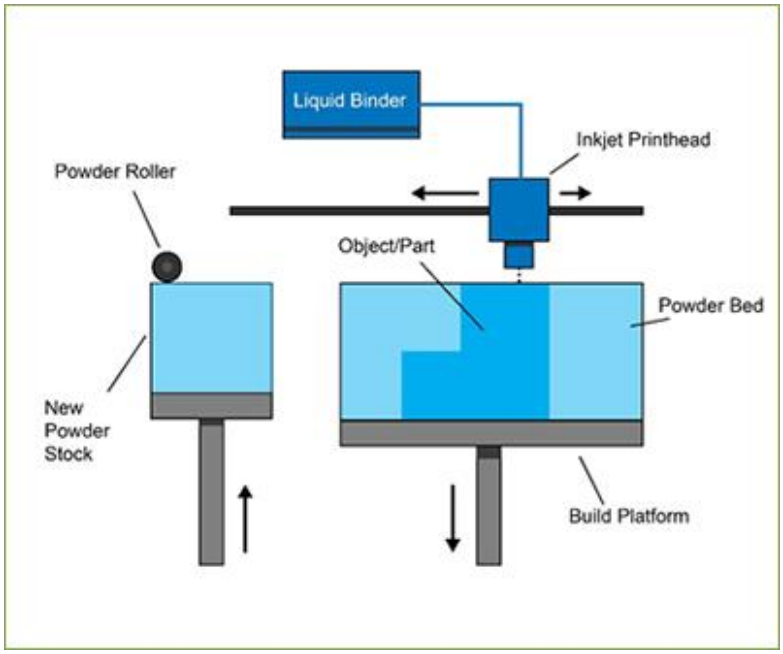
Direct Energy Deposition

Contrary to powder bed fusion, direct energy deposition uses a precise deposition of material only on the melting points for each layer, avoiding the excessive use of material portrayed previously. Energy source is also a laser beam or an electron beam with the possibility of sharing a coaxial nozzle (picture A) or a dual-head system (picture B). The material may be fed as a powder or as a wire that is melt by the power source during the deposition. This process requires a posterior heat treatment on most of the applications.



Binder Jetting

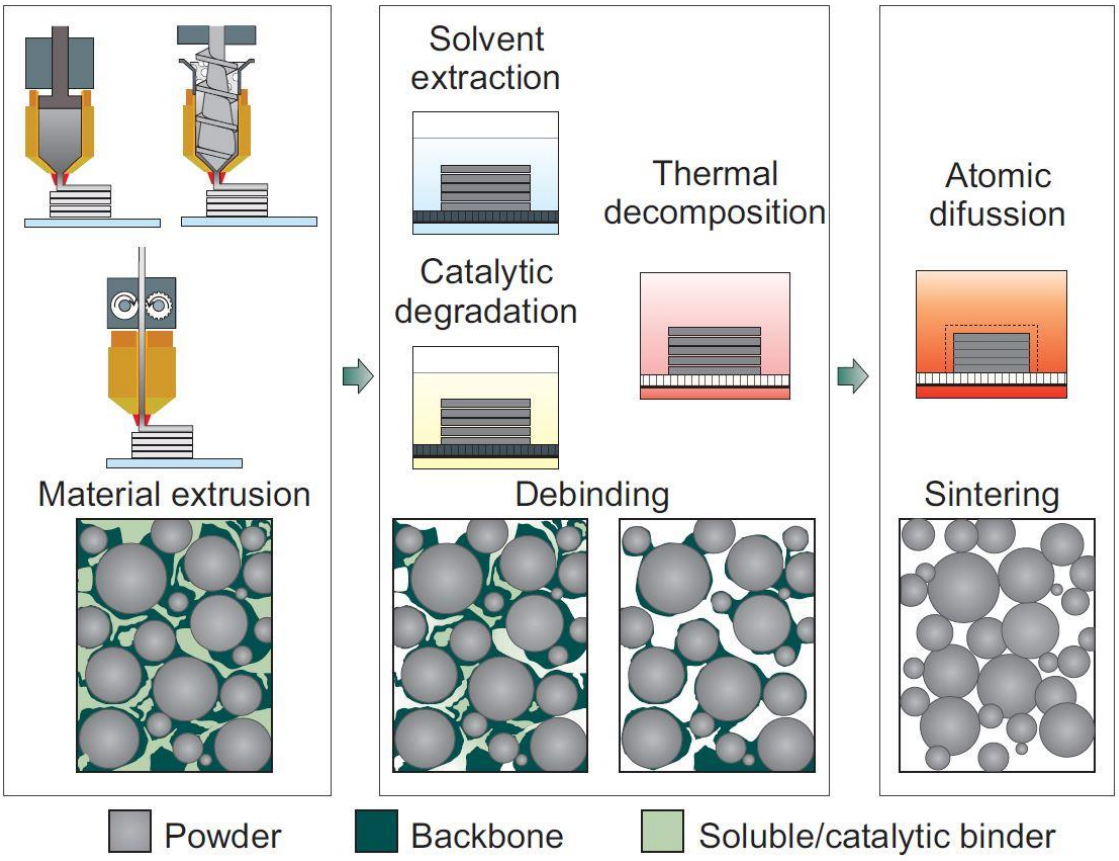
Binder jetting uses the same concept of spreading a layer of powder prior to the material joining, however, instead of using a melting form of joining the raw material, it uses a polymeric binder with the shape pretended for the cross section, similarly to a conventional 2D printer. After all layers are completed, the “green part” needs



to be sintered to become fully metallic as the binding material is burnt. Typically, the printing head consists of multiple binder jets.

Bound Powder Extrusion

This method is the most recent of those presented and gathers principles of each of the previous. The raw material consists of a polymer matrix with metallic powders disperse. Usually, the material is fed through a wire that is melt upon deposition similarly to a conventional 3D printer. The polymer binder is required to be extracted after printing and when removed, the part needs to be sintered to become fully functional.



Use of 3D printed metal components

The metallic 3D printed parts' demand has increased significantly and the applications vary from medical implants to aircraft components. When the products require high precision, complex shapes and high level of detail, 3D printing is the desired process. Adding to this, the conversion

from a CAD model to a final product is simplified with low costs for a reduced number of parts for batch.

It is possible to find more information about 3D printing, including applications, trends and its benefits for Education in the “3DP TEACHERS’ GUIDEBOOK”. Make sure you are following the “3DP TEACHER - implementation of 3D Printing in future education” project’s Facebook page to be the first to know when the guidebook is published on project’s website.