

# Industry 4.0 and additive manufacturing

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D printing with metal powder and a laser: laser direct metal deposition (LMD) involves melting metal particles in the focus area of a laser beam. A workpiece made from solid metal is produced, made purely from CAD data without a die casting mold and milling machines. Credit: Trumpf GmbH + Co. KG

At the World Economic Forum (WEF) in Davos a key topic is focusing on the "Digital Transformation of Industries". The fourth industrial revolution is imminent. It goes by the name "Industry 4.0" and is expected to fundamentally change, among other things, the production

methods and business models currently used in industrialized countries. Experts estimate that Industry 4.0 will result in virtual data merging with real production equipment. The resulting "smart factory" will bring customers and suppliers closer together, as production orders will be sent by the customer directly to the machine, and the production data will be transferred to the distribution partner in real time. Manufacturing will become leaner and faster and respond to customers' needs.

## **Additive Manufacturing – 3D printing in metal**

A key component in making Industry 4.0 a reality are machines that can produce the desired components faster, more flexibly and more precisely than ever before. Less prototype construction, fewer dies, less post-processing. In future it will have to be possible to turn data into components and products at an incredible speed.

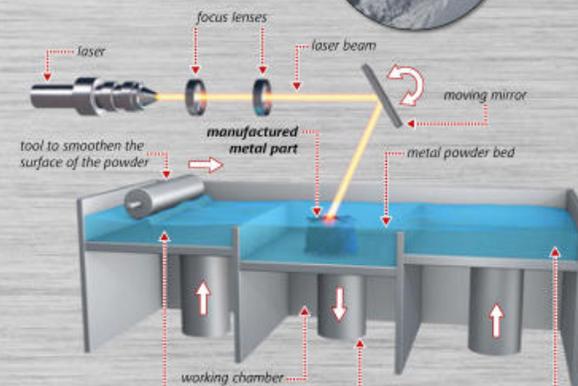
3D printers give a sneak preview of what this type of production might look like. The first of these devices were created in the 1980s, and nowadays you can buy entry-level devices for less than 700 Swiss francs. But so far, 3D printers have generally been used to make objects from plastic. The mechanical properties and the temperature stability of these objects are pretty limited as a result, which is why they are mainly used for illustrative purposes, i.e. as visual models. This is why 3D printing is often described as "rapid prototyping".

# Additive Manufacturing

The first 3D printing processes were developed in the 1980s. Nowadays, 3D printing as part of rapid prototyping is an established technology used to fabricate scale models from plastic very quickly and very flexibly in areas like architecture, engineering or surgery. In future, 3D printing is to be used to produce not only models but real, functioning components with sufficient mechanical properties and adequate heat resistance – as individual pieces and on a small series scale. This is only possible with metals or ceramics. At the moment, there are two methods for forming metallic objects with the help of metal powder and laser beams.

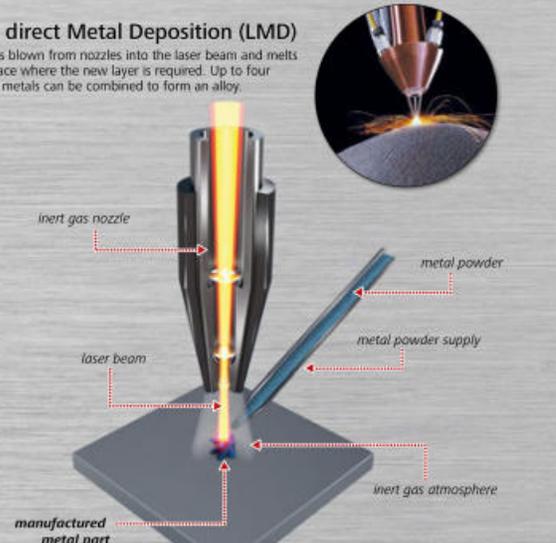
## Selective Laser Melting (SLM)

A laser melts powder in a powder bed. After each work step a new layer of powder is added to the resulting workpiece. Then the laser is used again and melts the next layer.



## Laser direct Metal Deposition (LMD)

Powder is blown from nozzles into the laser beam and melts at the place where the new layer is required. Up to four different metals can be combined to form an alloy.



Info graphics—Additive Manufacturing. Credit: Empa

For the fourth [industrial revolution](#), the technique used for 3D printing will have to go one step further: from [rapid prototyping](#) to Advanced Manufacturing, the production of lasting and functional components with defined mechanical and thermal properties: products made from metals or ceramics.

Empa, the Swiss Federal Laboratories for Materials Science and Technology, is working on this topic with various research groups. One group is examining the optimized use of lasers, while another is researching new types of alloys that this technology makes feasible for the first time. A further lab is using Additive Manufacturing to build new, geometric forms that were not possible up to now with the

traditional production methods available.

Provided by Swiss Federal Laboratories for Materials Science and  
Technology

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