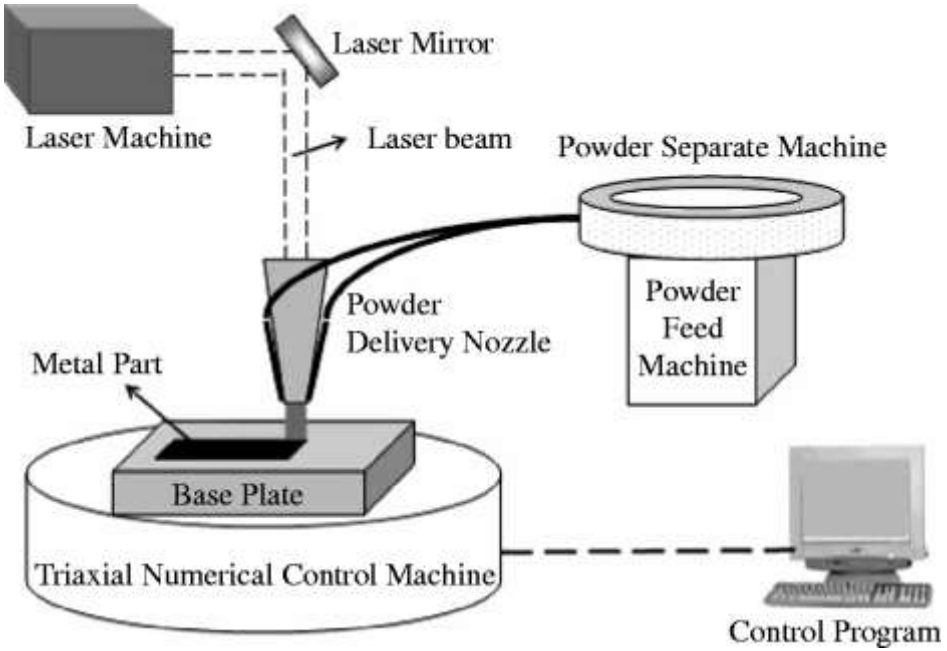
Hybrid technologies

Ing. Petr Keller, Ph.D.

Hybrid technologies

Additive + subtractive technologies

often DED + 5-axis milling



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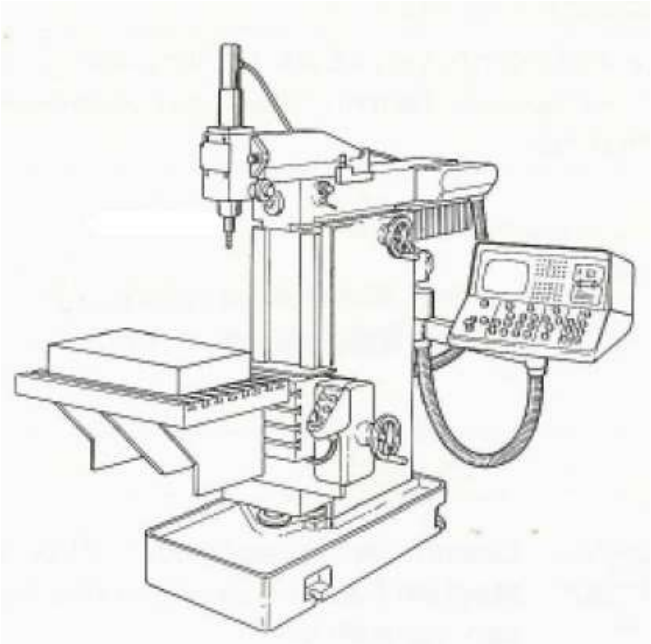
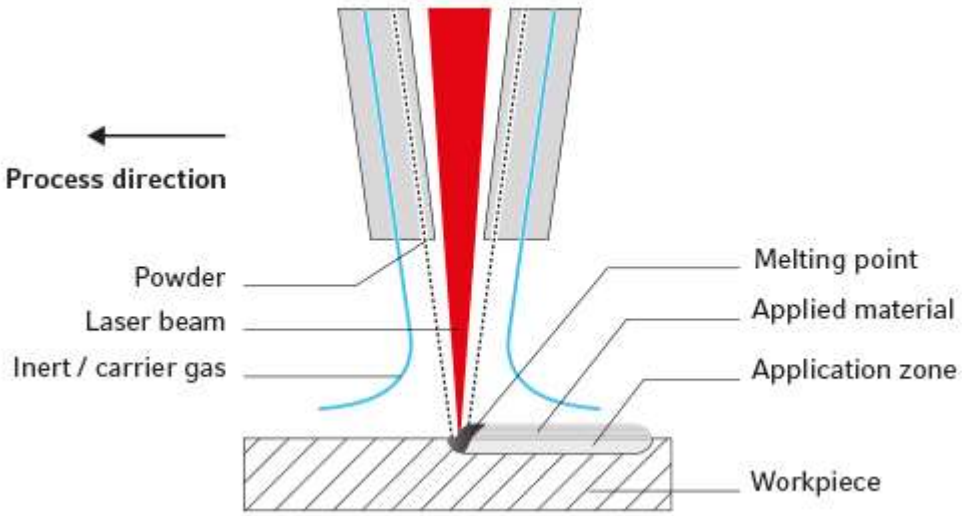


Source: http://blog.cafefoundation.org/?p=8410

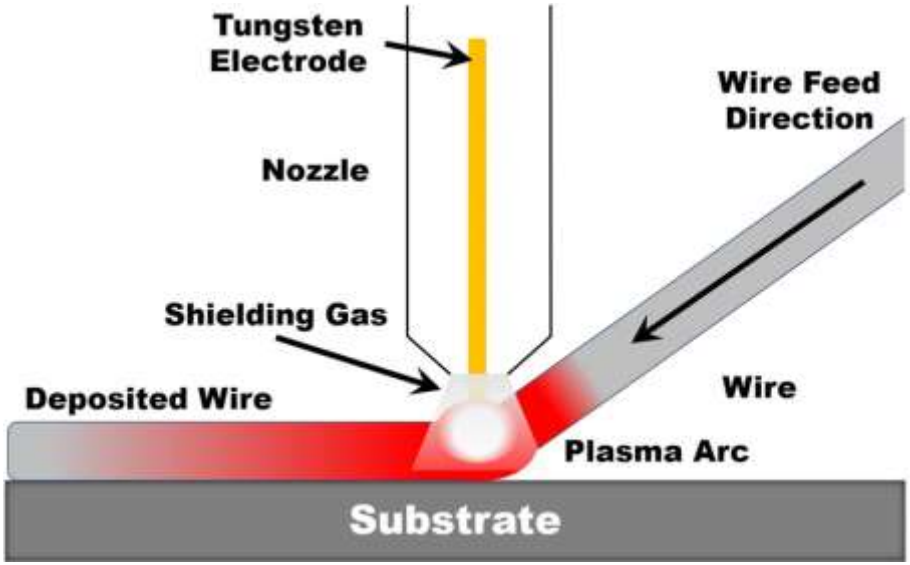
Directed Energy Deposition – Laser cladding

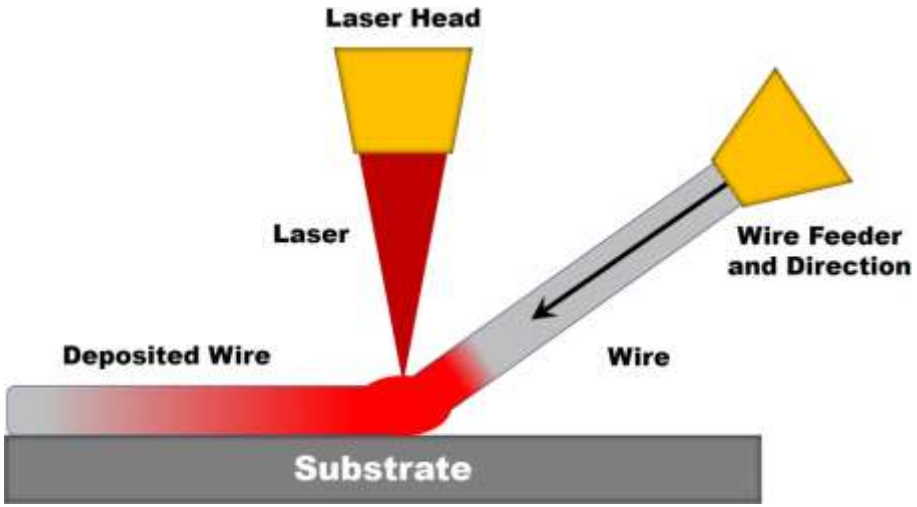
Laser welding of metal powder by very powerful laser, even with adaptive control of laser power.



Source: http://www.dmgmori.com/webspecial/journal_2014_1/en/lasertec-65.htm

Directed Energy Deposition – MIG / MAG / TIG welding, LENS



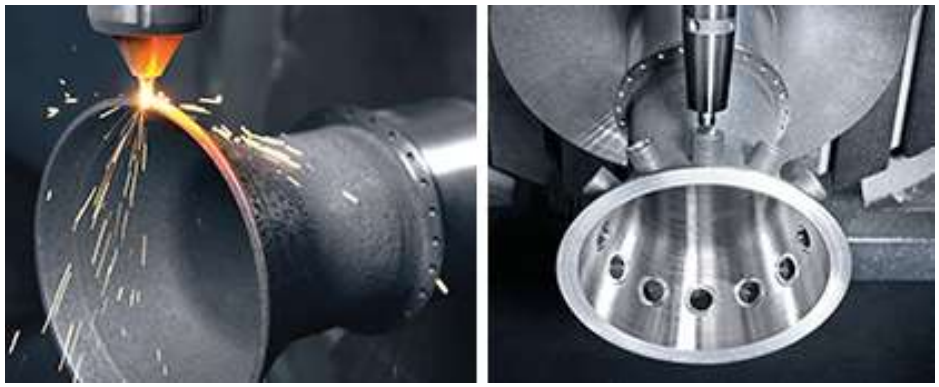


Source: https://doi.org/10.1007/s11663-019-01612-1

Hybrid technologies

- machines enabling the parts production of the combination of machining technology with other technologies, often just with additive technologies

- integration of welding head (eg. laser cladding technology) to five-axis milling centers or multifunction machining centers



Source: dmgmori.com

Hybrid technology – DMG Mori

Laser deposition + five-axis milling

Source: dmgmori.com

Hybrid technology – DMG Mori

Source: dmgmori.com

Hybrid technology – DMG Mori

Zdroj: dmgmori.com

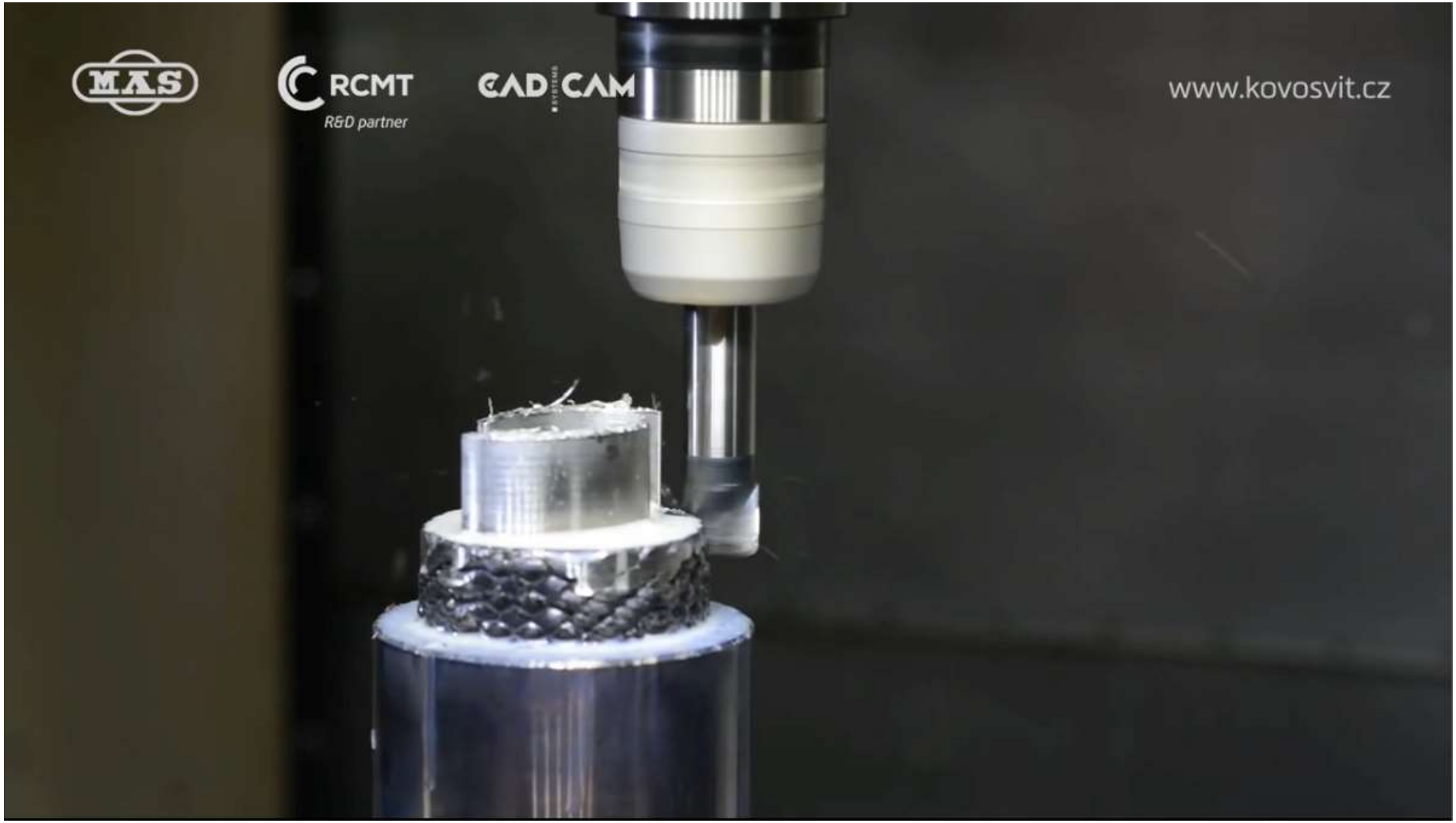
Hybrid technology in Czech Republic

WeldPrint – completely developed in CZ
(Kovosvit MAS in cooperation with CTU Prague)

It allows to create metal parts by arc welding and machining them in one workspace at a significantly lower cost than other 3D metal printing technologies.

The WeldPrint 2 is based on the concept of the new five-axis milling machine MCU 450 with a portal support structure.

Hybrid technology – WeldPrint



Source: www.masmachinetools.cz

Hybrid technology – WeldPrint

Features of WAAM technology

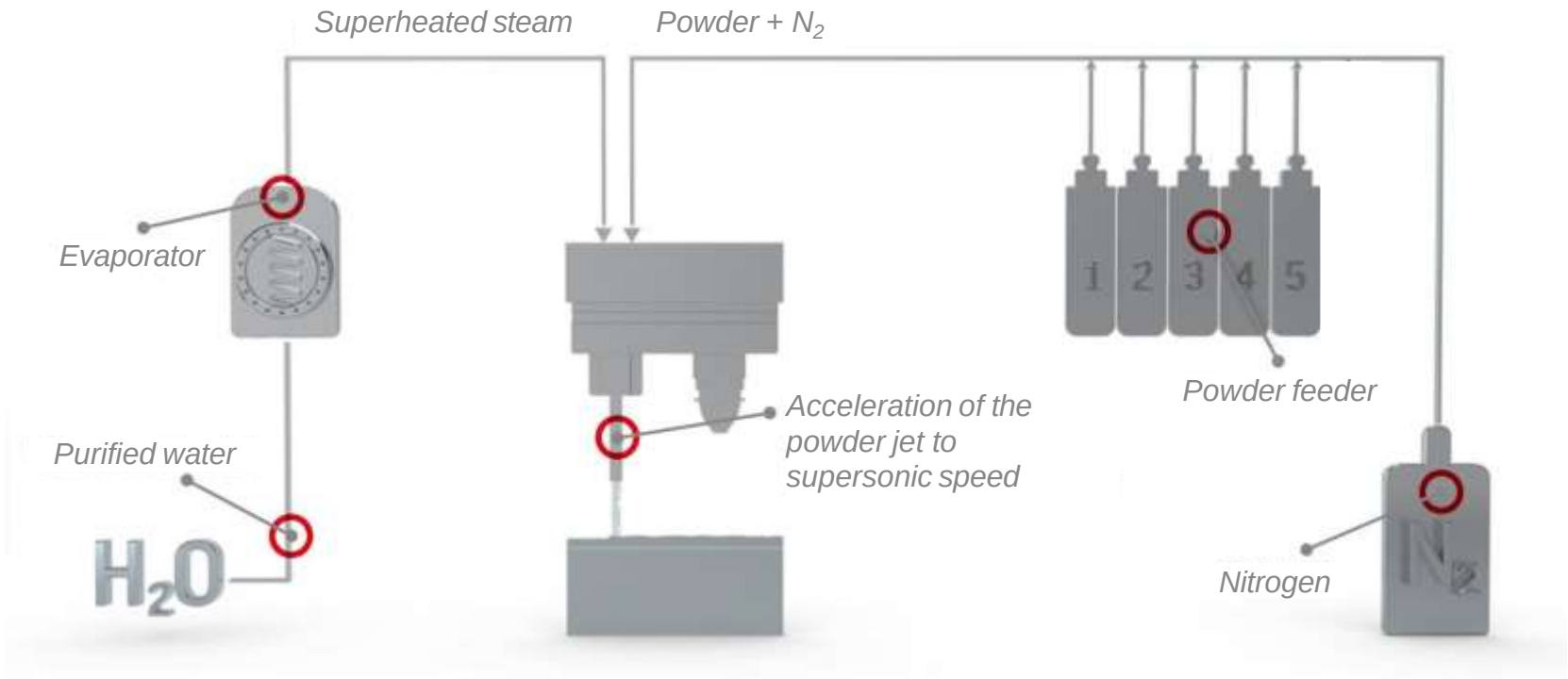
(Wire and arc additive manufacturing)

- Up to 70% cheaper than laser hybrid technologies
- Combination of additive and subtractive manufacturing in one workspace
- Fast part creation due to high process speed
- Complex parts approx. ø500 mm and 480 mm high (max. weight 400 kg)
- Possibility to build lightweight internal structures
- Possibility to produce new parts as well as to repair parts
- Development since 2013 (Kovosvit MAS + CTU)

Hybridní technologie

Metal-Powder-Application (MPA) by Hermle

Machine schematic

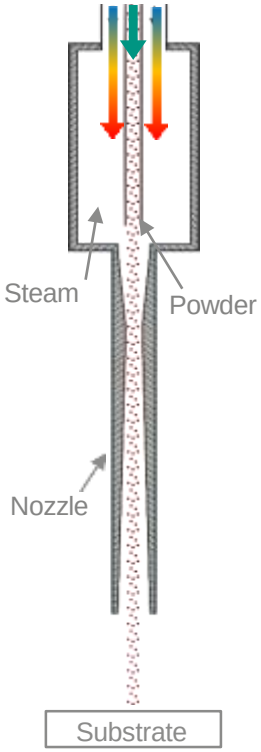


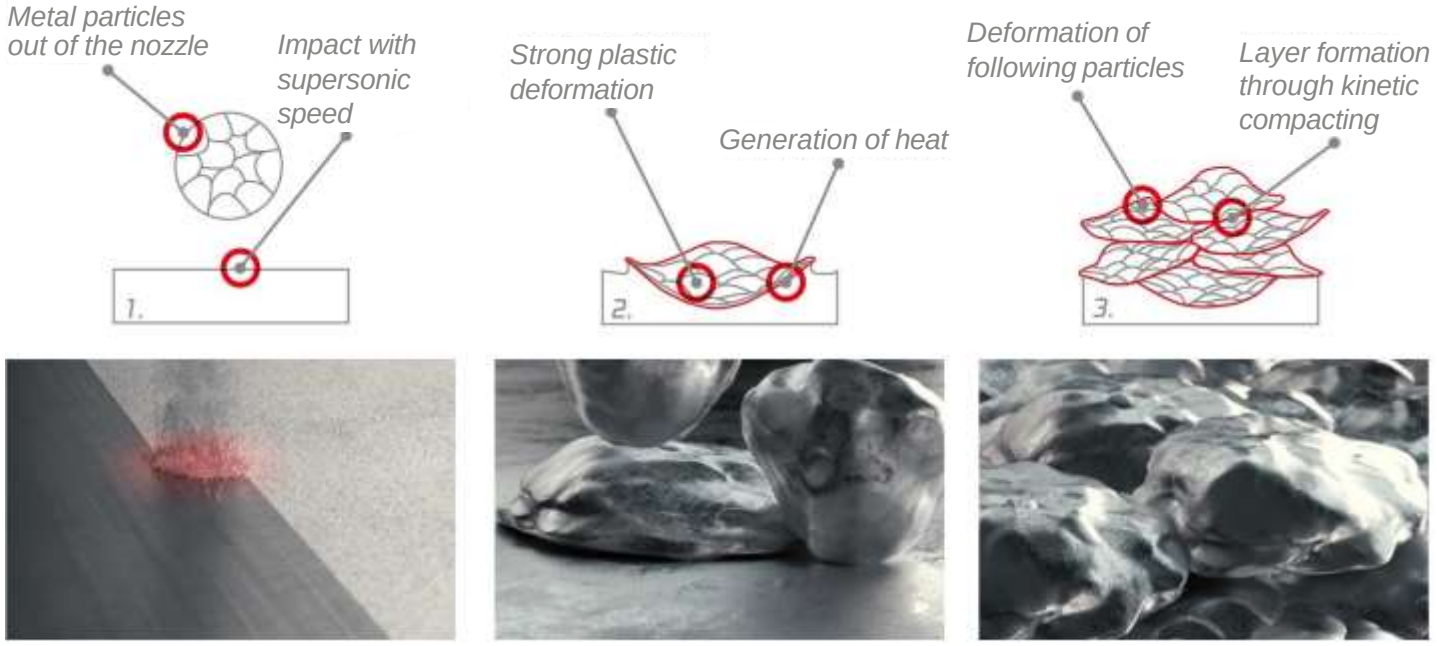
Source: https://www.hermle.de

Hybridní technologie

Metal-Powder-Application (MPA) by Hermle

Application mechanism





Source: https://www.hermle.de

Hybrid technology

Metal-Powder-Application (MPA) by Hermle

Source: https://www.youtube.com/watch?v=s6jTw5VQgvI

Hybrid technology

Metal-Powder-Application (MPA) by Hermle

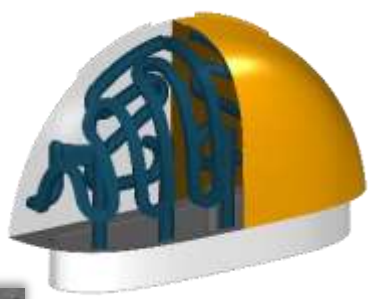
Material diversity

Source: https://www.hermle.de

Hybrid technology

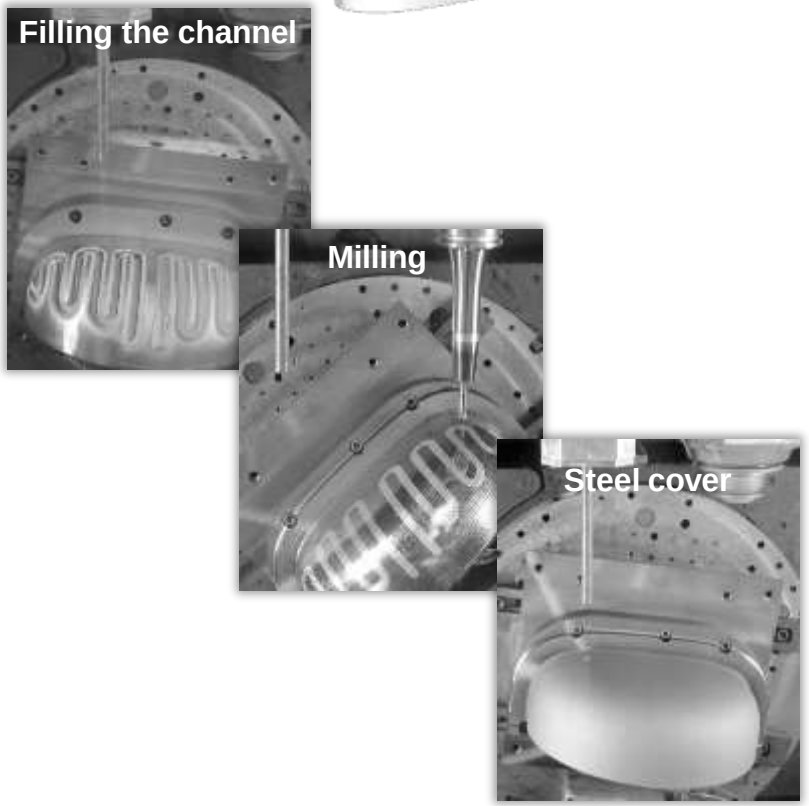
Metal-Powder-Application (MPA) by Hermle

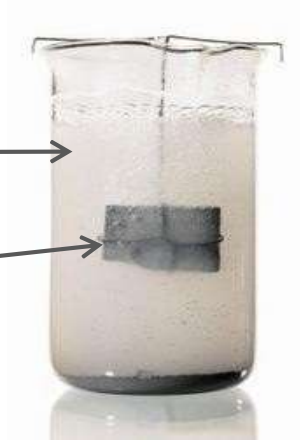
Application examples – cooling channel



Water dissolvable filling material.
Good machinability
Allows cavities / cooling channels

- Processing with MPA
- Good machinability
- Allows cavities / cooling channels





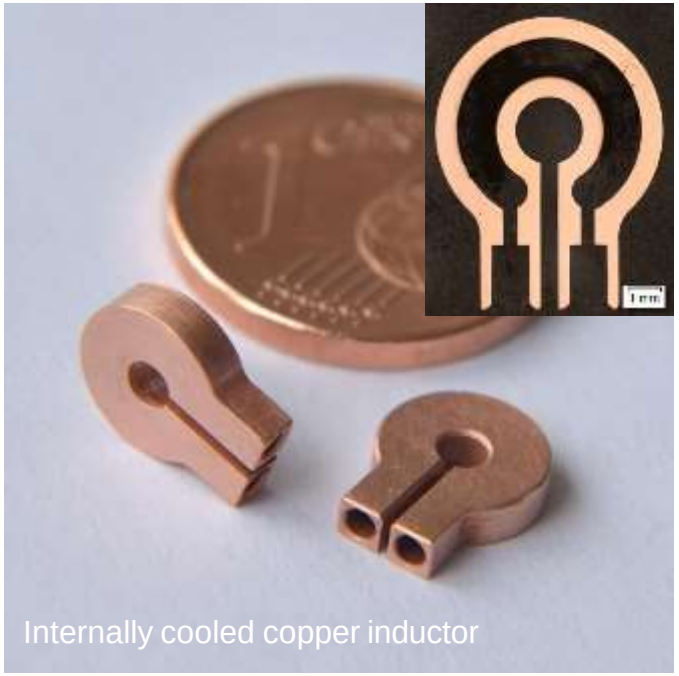
Source: https://www.hermle.de

Hybrid technology

Metal-Powder-Application (MPA) by Hermle

Application examples - component sizes

Few grams



Hundreds of kilograms

Tool for press hardening

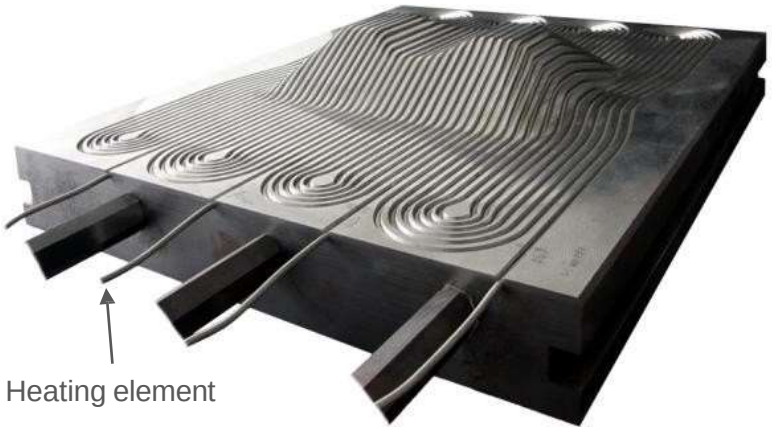
1.2367
(H10)

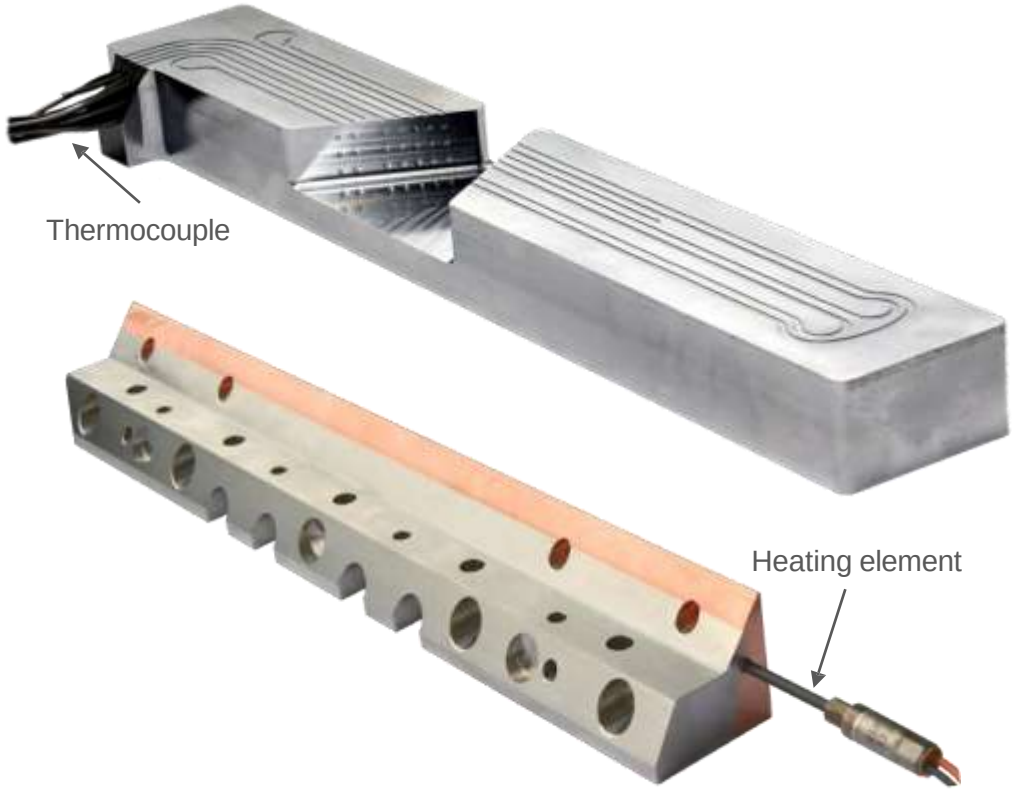
Source: https://www.hermle.de

Hybrid technology

Metal-Powder-Application (MPA) by Hermle

Application examples – functional components





Source: https://www.hermle.de

Hybrid technology

Metal-Powder-Application (MPA) by Hermle

MPA at a glance

- A service provided by Hermle
- Combination of generative and subtractive manufacturing
- Fast material build-up due to high build rates
- Complex components from 2x10 mm to approx. 650x650 mm
- Conformal cooling channels and cavities
- Multi-material components
- Superior thermal management
- Single part to series production
- Optimal material properties
- Continuous development through R&D expertise

Source: https://www.hermle.de

Advantages of hybrid technologies

- metal parts
- combination of machining and AM → "unlimited" shapes and high precision and surface quality
- possibility to combine multiple materials within a single part
- possibility to repair a layer / part if necessary

Disadvantages of hybrid technologies

- problem with internal stresses in the material in technologies that weld layers using a heat source (laser, arc)
- currently very expensive technologies
- software development was significantly delayed compared to technology development - a few years after the first machine was launched, there was no software combining support for machining (CAM) and material deposition