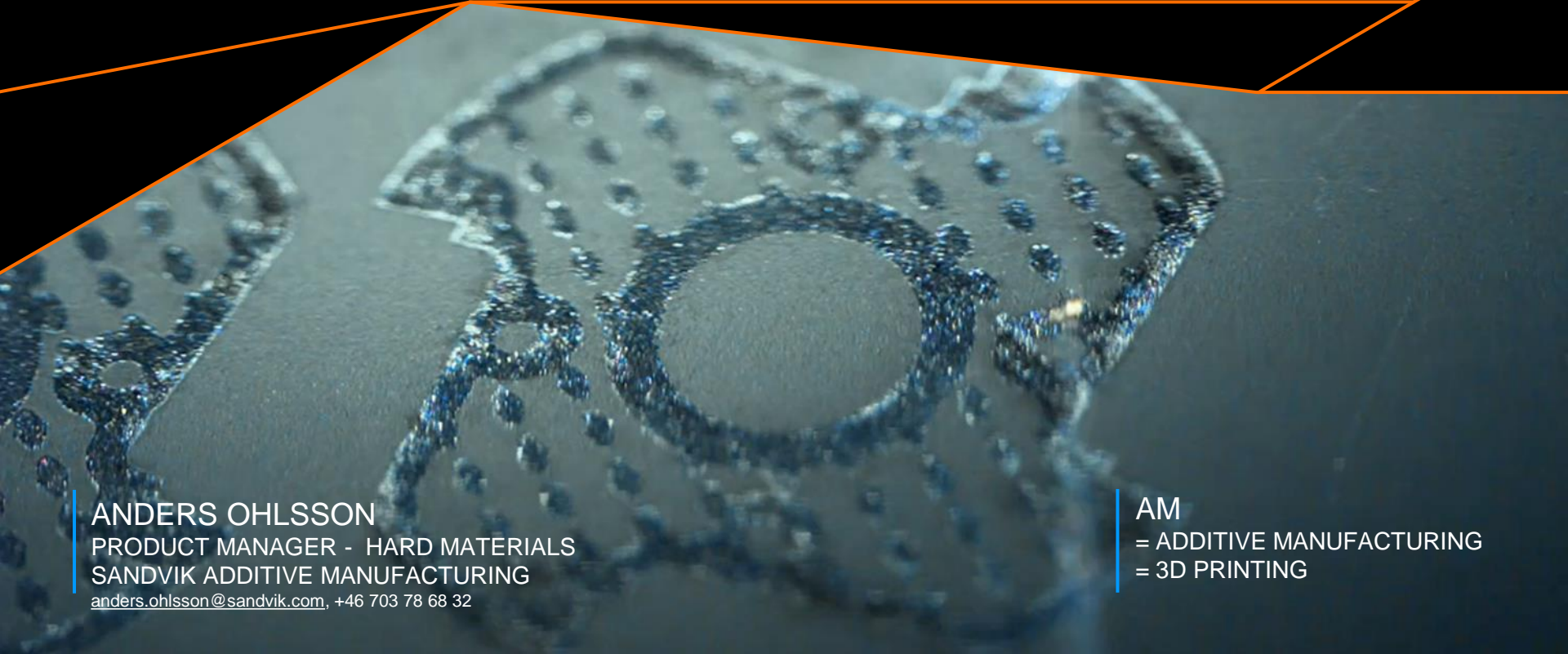


# ADDITIVE BY SANDVIK



ANDERS OHLSSON

PRODUCT MANAGER - HARD MATERIALS  
SANDVIK ADDITIVE MANUFACTURING

[anders.ohlsson@sandvik.com](mailto:anders.ohlsson@sandvik.com), +46 703 78 68 32

AM

= ADDITIVE MANUFACTURING  
= 3D PRINTING

# SANDVIK GROUP

WORLD LEADING POSITION IN...

METAL  
CUTTING

MINING  
AND ROCK  
TECHNOLOGY

ADDITIVE  
MANUFACTURING  
R&D and Internal

MANUFACTURING  
SOLUTIONS "NEW"

- Additive Manufacturing
- Metrology
- CAM

ADVANCED MATERIALS  
TECHNOLOGY

37 000  
EMPLOYEES

86

BILLION SEK  
IN REVENUES

60

R&D CENTERS  
GLOBALLY

SALES IN OVER

160

COUNTRIES  
AROUND THE GLOBE

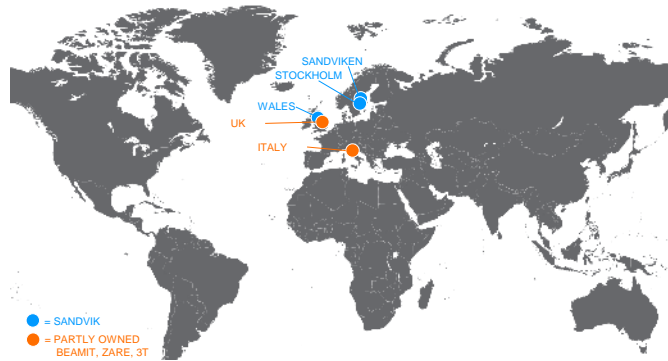
3.4 BILLION SEK  
ANNUAL R&D  
INVESTMENT

6,000

ACTIVE PATENTS

# SANDVIK ADDITIVE MANUFACTURING

## FOOTPRINT



## PRODUCT OFFERINGS

METAL  
POWDER

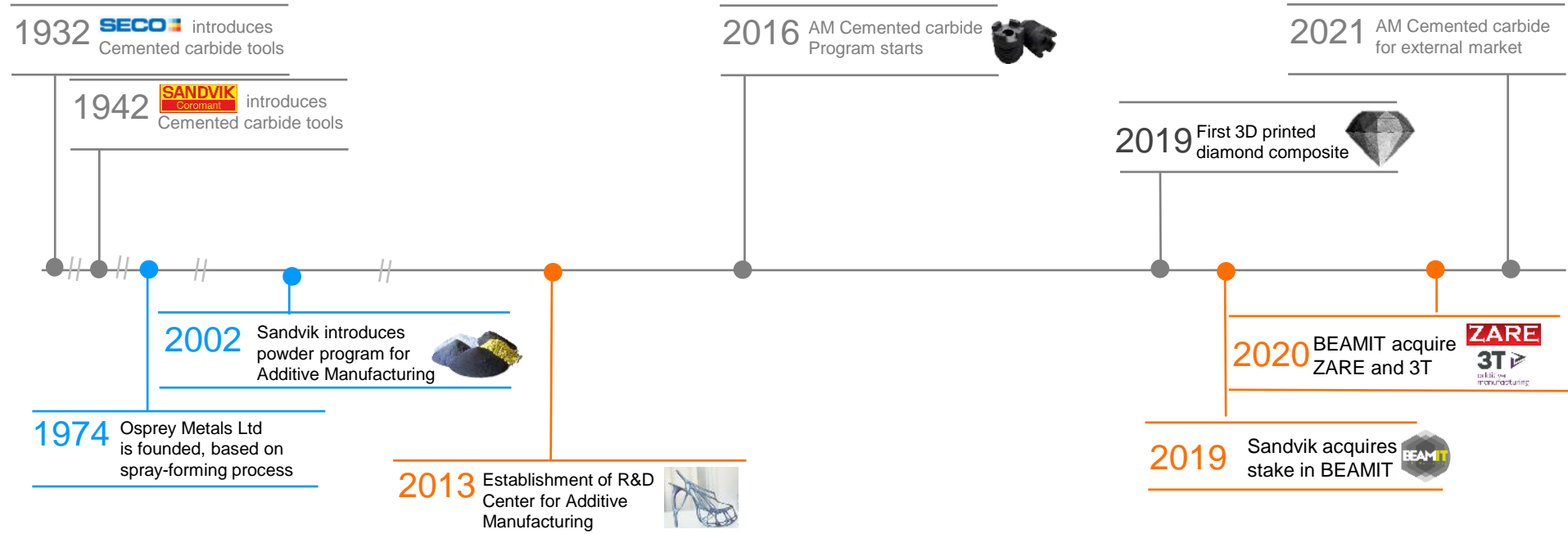


ADDITIVE  
MANUFACTURING  
SERVICES



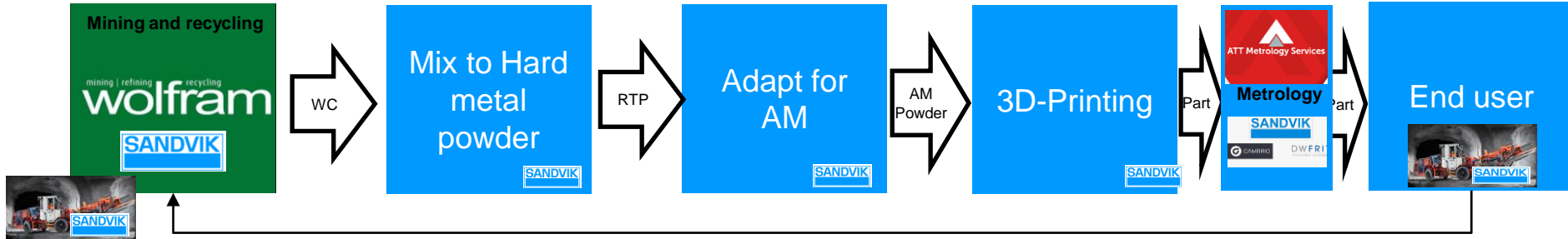
# MATERIALS AND MANUFACTURING

## SINCE 1862...

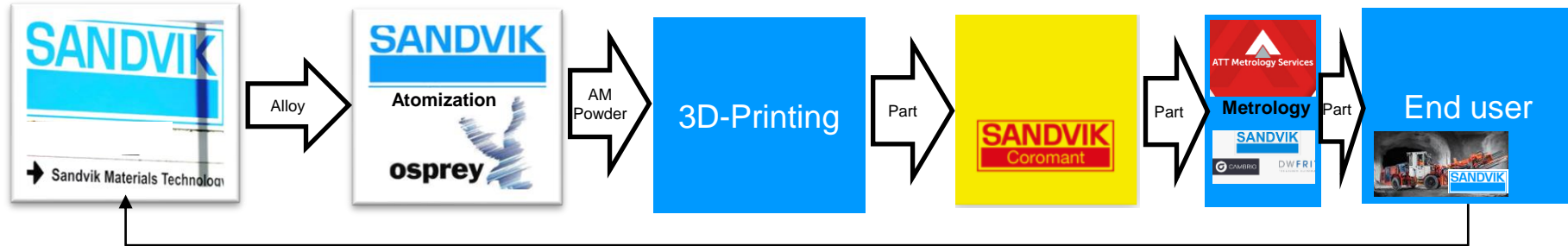


# FROM THE MINE AND BACK AGAIN

## Cemented Carbide



## Metal



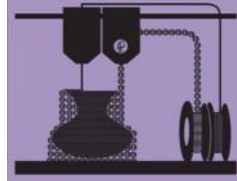
# 7 FAMILIES OF ADDITIVE MANUFACTURING



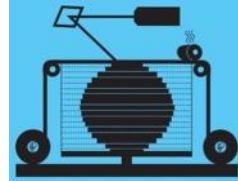
VAT  
PHOTOPOLYMERIZATION



MATERIAL  
JETTING



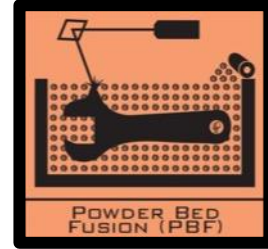
MATERIAL  
EXTRUSION



SHEET  
LAMINATION



DIRECTED ENERGY  
DEPOSITION (DED)



POWDER BED  
FUSION (PBF)



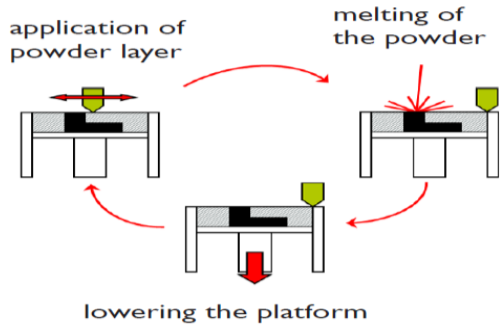
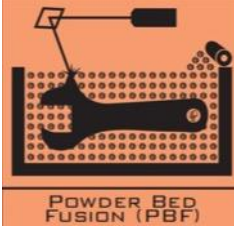
BINDER  
JETTING

METAL AM IS UNDER DEVELOPMENT FOR ALL

# POWDER BED FUSION - LASER

MATURE, ACCURATE

86%



- Micro welding with laser
- Build speeds 5-150 cm<sup>3</sup> /hr
- Support structures needed

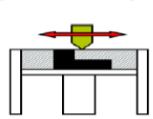


# BINDER JETTING

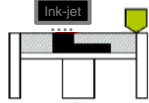
FLEXIBLE, HIGH PRODUCTIVITY



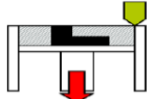
application of  
powder layer



Gluing of  
the powder



lowering the platform



Sintering

- Green body technique
- Glued powder followed by Sintering
- Build speeds up to 8200 cm<sup>3</sup>/hr\*





# BINDERJET – A COMING REVOLUTION?

L~100mm



L~40mm



**2018:** 2 Printer manufacturers

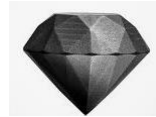
**2021:** 7+ Printer manufacturers, including HP, GE, DM.

**Why:**

1. High Productivity → Low Cost
2. New Materials (MiM+)
3. No/Less need for AM-design

# WHERE/WHY CAN AM MAKE SENSE

- Volume Production
  - Significant performance improvement with very complex geometries
  - Mass-customization / Large families, complex geometries
  - Difficult to machine materials, e.g.



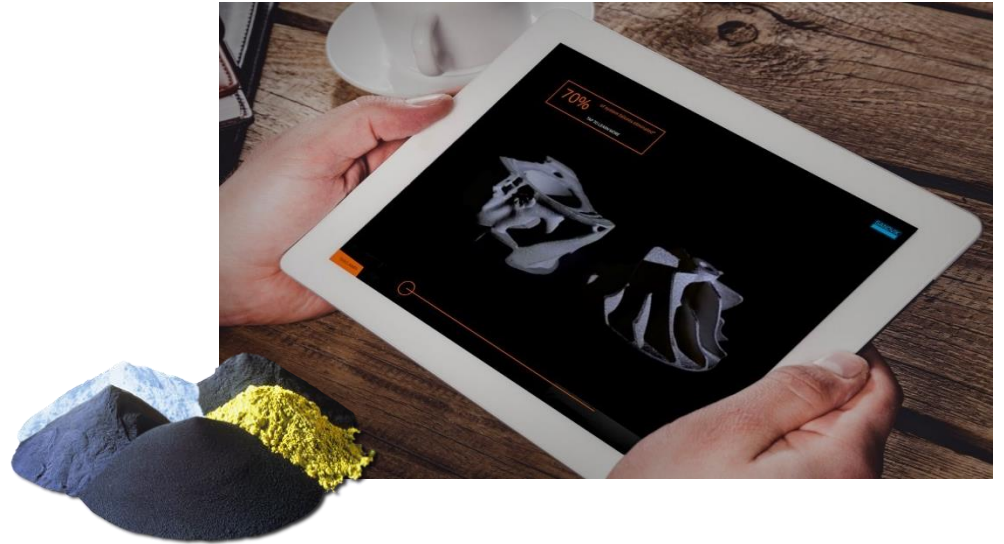
- Small Volume
  - Prototypes / R&D (e.g. Castings)
  - Spare parts (future)

Patents filed for certain developed processes

# MATERIALS IN FOCUS TODAY

## SANDVIK AM CENTER

- Light weight      **Ti6Al4V (Grade 5 and 23)**
- Stainless        **SAF2507**
- Hard materials   **Cemented carbide / Hard metal**
- Super Hard      **Diamond Composite**

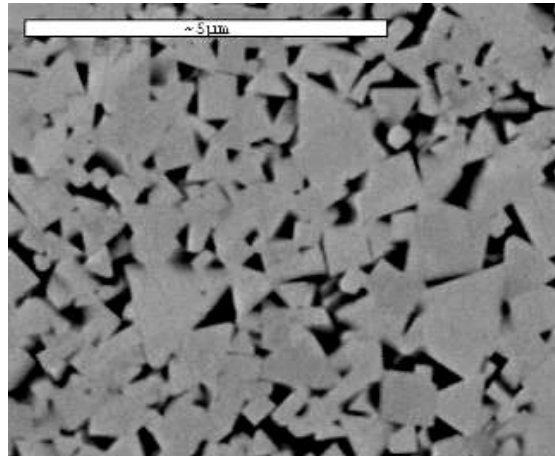
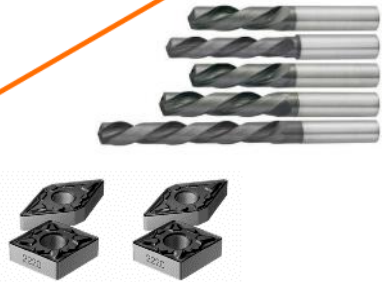


Patents filed for certain developed processes



# CEMENTED CARBIDE

“TUNGSTEN CARBIDE” “CARBIDE” “HARD METAL” ...



- WC + Co
- Hardness, Wear Resistance, Durability



# CEMENTED CARBIDE - AM

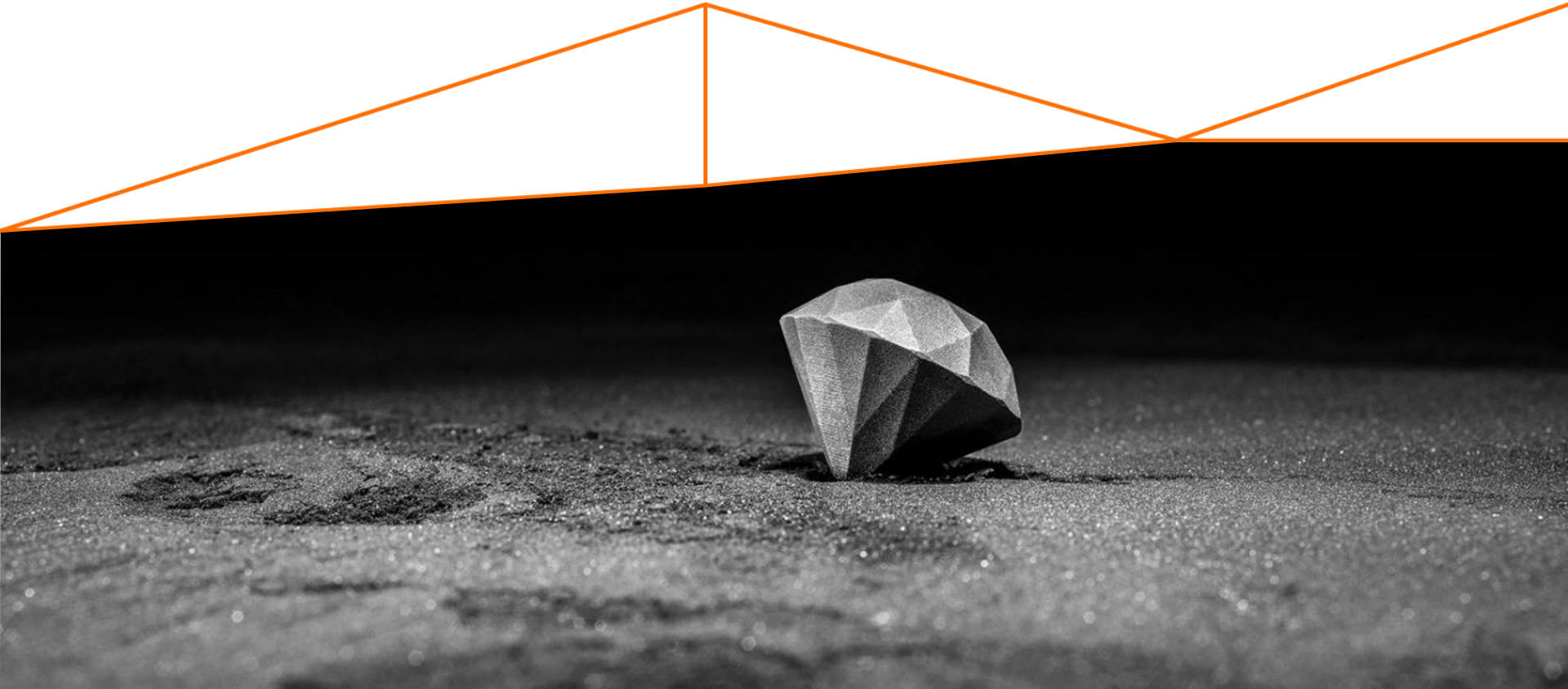
Traditional Manufacturing



# DIAMOND COMPOSITE

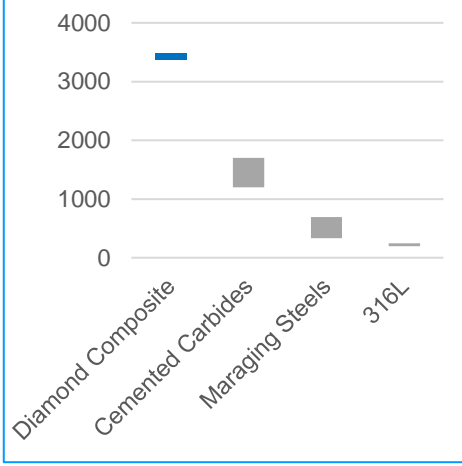


THE WORLDS FIRST 3D-PRINTED DIAMOND COMPOSITE

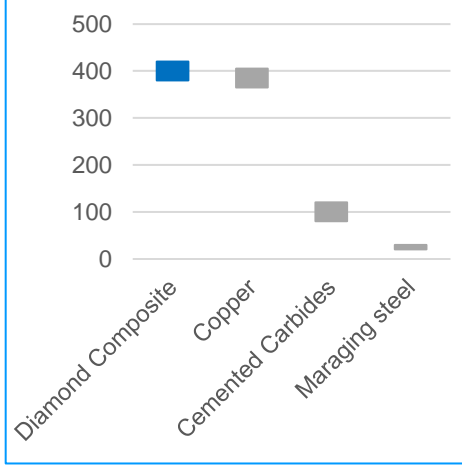


Under Development

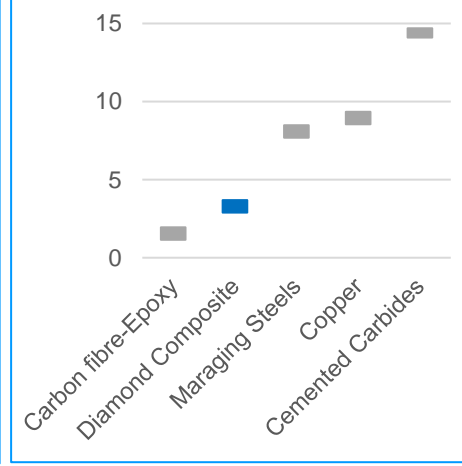
### HARDNESS (HV)



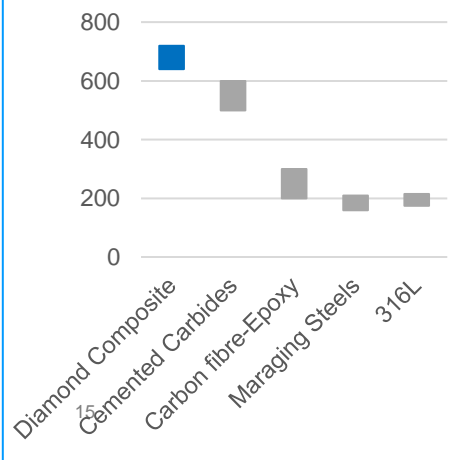
### THERMAL CONDUCTIVITY



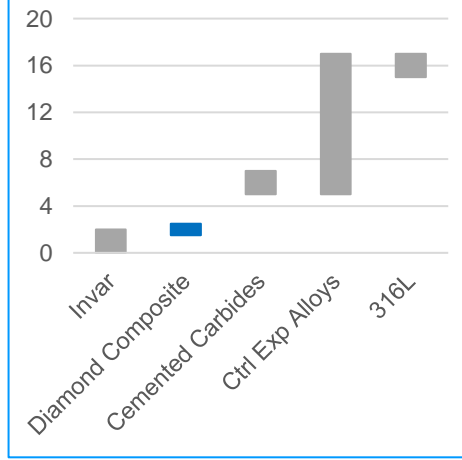
### DENSITY



### YOUNGS MODULUS



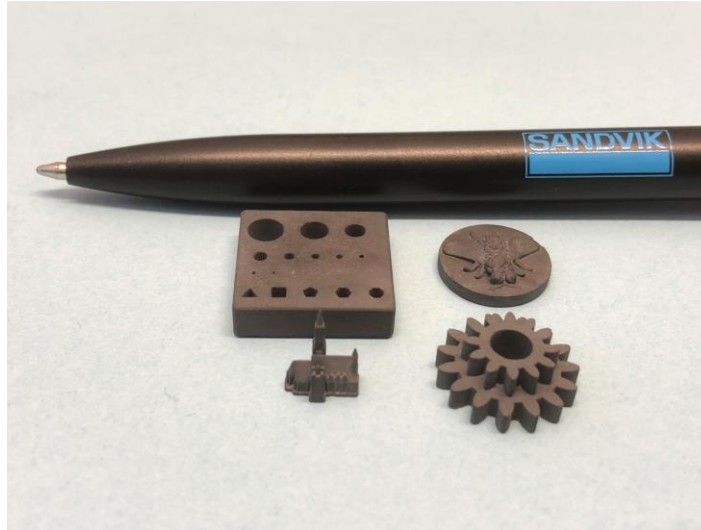
### THERMAL EXPANSION



SEVERAL EXTREME PROPERTIES  
+  
3D GEOMETRIC DESIGN FREEDOM



# EXEMPELS - DIAMOND COMPOSITE

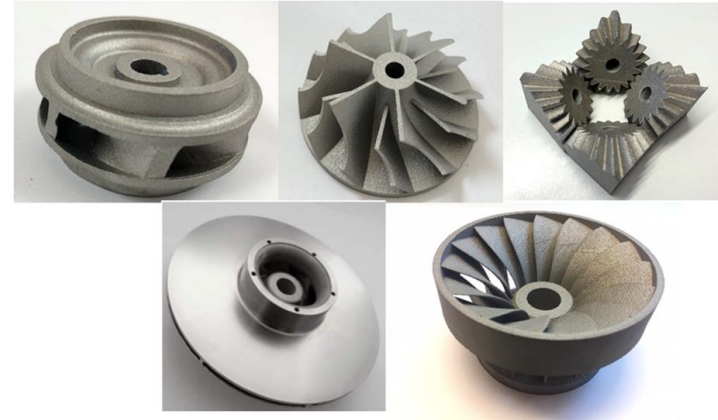




# MATERIAL- OSPREY®2507

## SuperDuplex Stainless Steel

- Excellent resistance to stress corrosion cracking (SCC) in chloride-bearing environments
- Excellent resistance to pitting and crevice corrosion
- High mechanical strength
- Good weldability



Sea Water  
Chloride environment  
+  
High Mechanical Loads  
=  
Osprey® 2507

Chemical composition (nominal) %

C	Si	Mn	P	S	Cr	Ni	Mo
≤0.030	≤0.8	≤1.2	≤0.025	≤0.015	25	7	4

Others  
N=0.3



# TITANIUM TI-6AL-4V

- Light
- Strong
- Corrosion/Oxidation resistant
- Bio-Compatible → Implants and Jewelry
- Traditional manufacturing:
  - Expensive and difficult to machine



CUSTOMER CASE

# COROMILL® 390



More than...

# 80%

REDUCED WEIGHT  
compared to conventional 390

Up to...

# 200%

INCREASED  
PRODUCTIVITY

**DESIGNERS:** Per Wiklund, Johan Lindström, Anna Nordstrand

**MATERIAL:** Titanium alloy, Ti6Al4V

**AM TECHNOLOGY:** Powder Bed Fusion Laser

**POST PROCESSING:** Heat treatment and machining



## DESIGN THE UNSEEN OPTIMIZE PERFORMANCE



“With the new light-weight CoroMill® 390, produced with AM, the weight of the cutter body is reduced by >80%. Combined with new Silent Tools™ milling adaptors, this is an exceptional tooling combination for slender tooling. The solution limits the vibration tendencies and enables high productivity and good process security in demanding applications.”

**THOMAS WIKGREN**

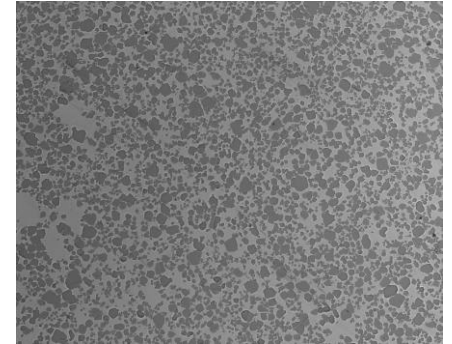
**PRODUCT MANAGER SHOULDER MILLING, SANDVIK COROMANT**



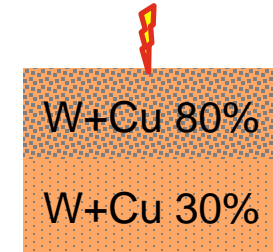
THOUGHTS ON ADDITIVE MANUFACTURING APPLIED ON  
- HIGH VOLTAGE  
- MINING

# WEAR RESISTANT & CONDUCTIVE

- W or WC + Cu or Bronze
- Circuit breaker electrodes
- Any geometry
  - Skin effects? Field optimization? Eliminate connection points? Compact products?
- Gradient Materials

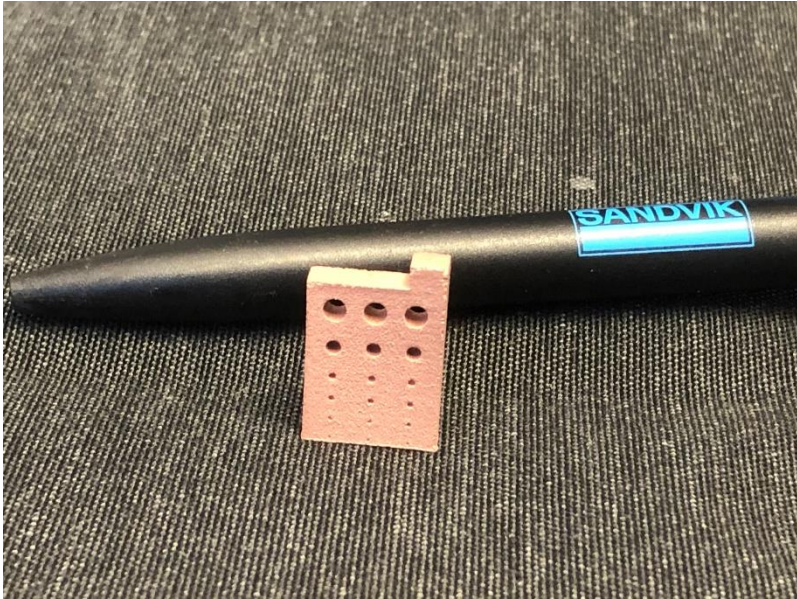


W + Cu



Gradient materials

# PURE CUPPER BY BINDERJET AM



- Cu Components in any shape.
- First tests
- Density 95%
- Resistivity 0,028Micro-ohm-meter

Room for improvement

# MINING

# LKAB WASSARA



Simplified  
assembly and  
optimized design

---

Increased  
life-time and rate  
of penetration



**DESIGNERS:** Per Viklund, Maria Bengtsson

**MATERIAL:** Osprey™ 18Ni300

**AM TECHNOLOGY:** Powder Bed Fusion Laser

**POST PROCESSING:** Hardening and machining

## SIMPLIFIED ASSEMBLY, OPTIMIZED DESIGN FOR IMPROVED PRODUCTIVITY

“Additive manufacturing gives us the possibility to optimize the design of our hammers with fewer components and streamlined water channels. Initial tests in production environment made with W70 sliding case from Sandvik AM show very promising results, indicating improved life time and increased rate of penetration.”

**MARIA BENGTTSSON**  
SENIOR ENGINEER, LKAB WASSARA





## CUSTOMER CASE

# VAREL NOZZLES



Customization  
50-70%  
shorter lead times  
Reduced inventory

**DESIGNERS:** Magnus Boström, Bruno Cuillier

**MATERIAL:** Cemented Carbide, WC12Co

**AM TECHNOLOGY:** Binder Jetting

**POST PROCESSING:** Sintering and sand blasting

## JUST-IN-TIME AM DELIVERY FLEXIBLE CUSTOMIZATION

“Today the nozzles are manufactured with traditional methods, which is a long process with long lead times. For Varel it means that we need to keep a large inventory to be able to serve our customers in the oil and gas industry. With AM we can receive parts faster and can reduce our inventory significantly.”

**BRUNO CUILIER**  
GLOBAL PRODUCT ENGINEERING DIRECTOR, VAREL

