

GTV Laser Cladding



Tailored Laser Cladding Solutions

Andreas Wank

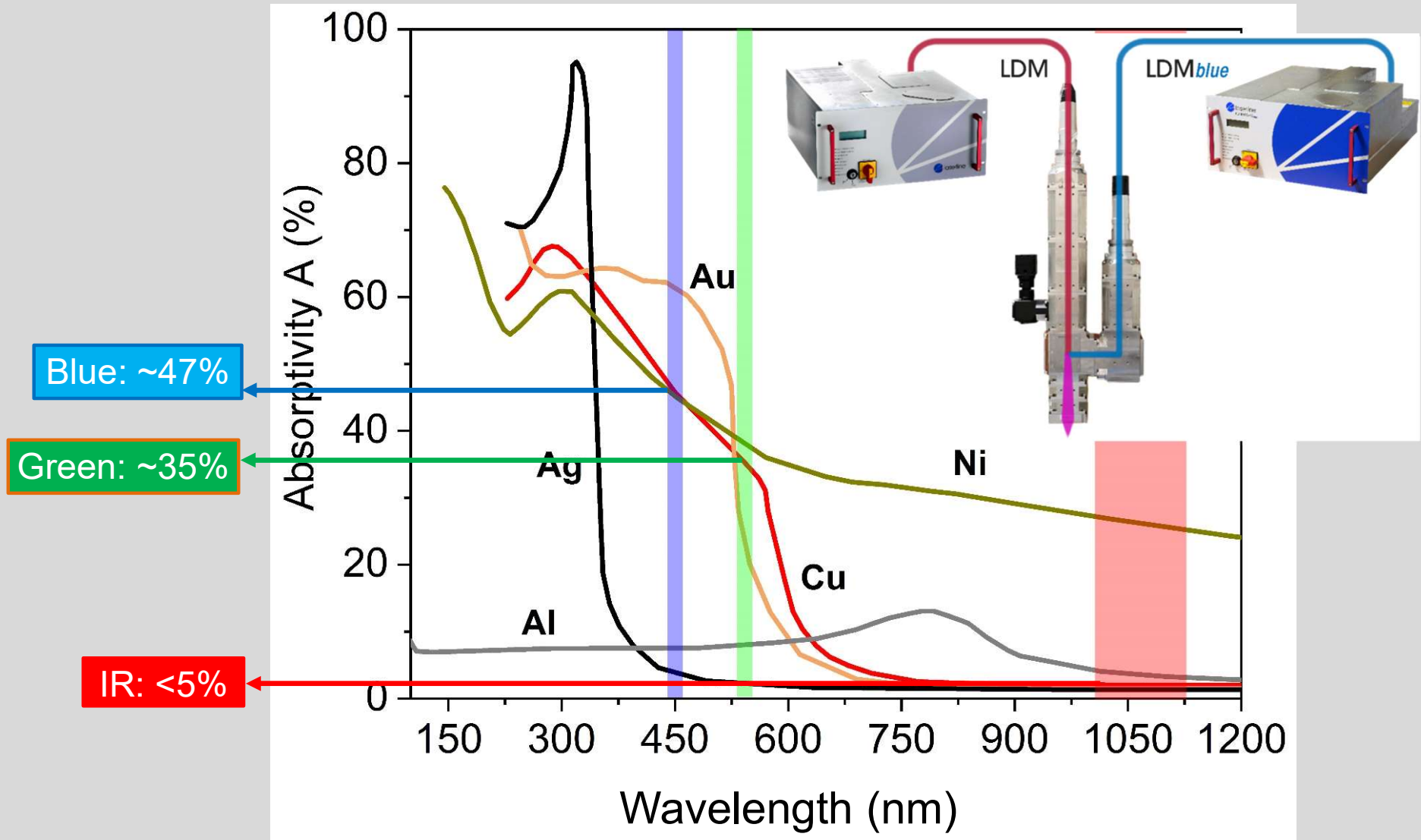


Outline



- **Blue Lasers for Cladding of Noble Metals**
- **Sensors and Actuators for Near-Net-Shape Cladding Processes**
- **High Speed Laser Cladding Process**

Why Blue Lasers?



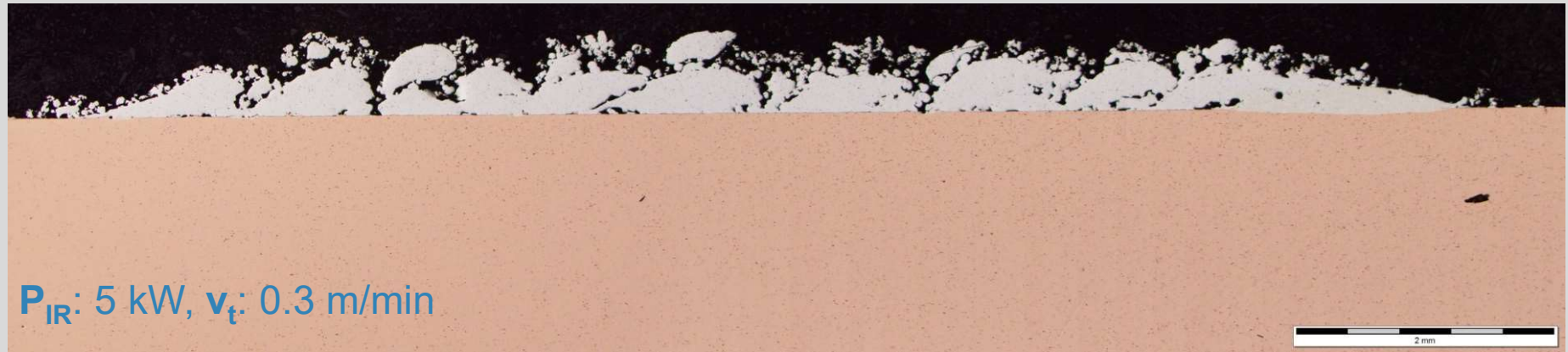
- Solid copper reflects > 95% of 1 μm radiation; strongly increased absorption (~25%) of liquid copper prevents heat conduction welding

Why Blue Lasers?



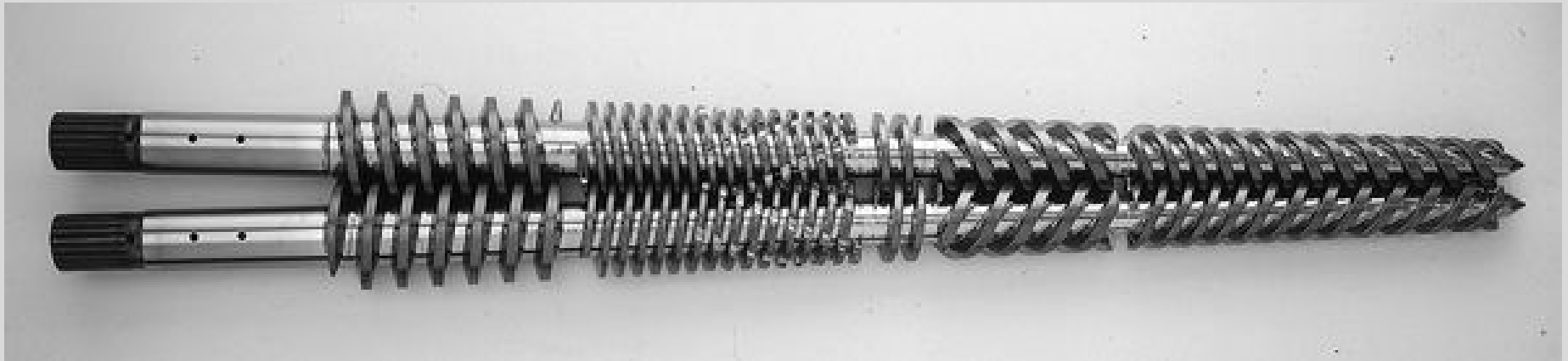
- Silver claddings on 0.45% carbon steel
- Blue laser is partially absorbed by silver powder and results in more homogeneous weld penetration, smoother cladding surface and lower porosity level compared to use of IR laser

Why Blue Lasers?



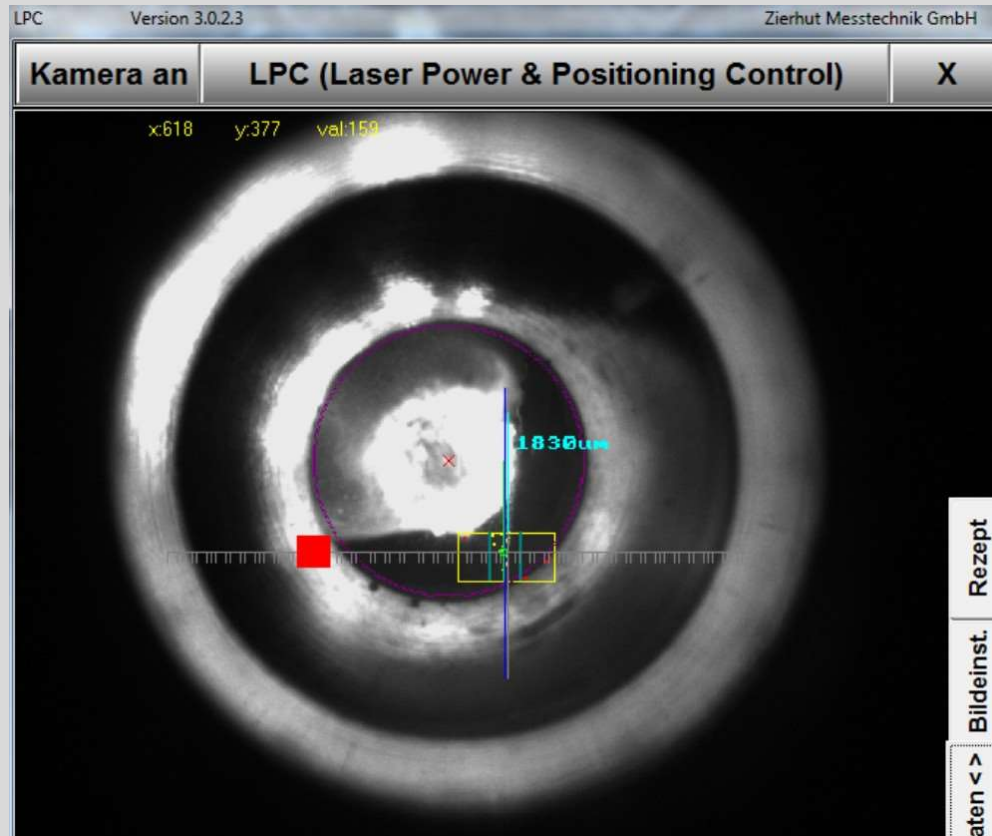
- Silver claddings on OF copper
- Blue laser contribution permits effective heat transfer to silver powder
- Further parameter optimization needed to avoid pore formation and excessive dilution with base material

Sensors and Actuators

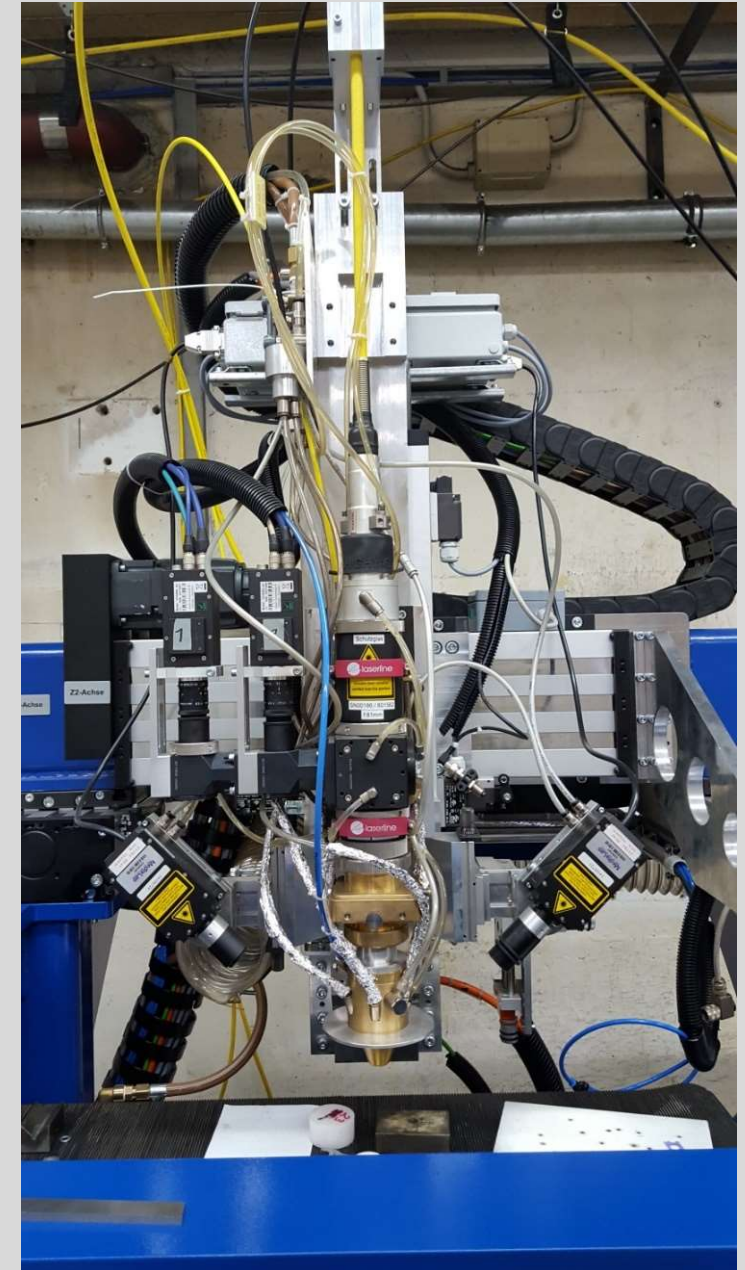


- Near net shape cladding permits extrusion screw wear protection with post machining by belt grinding only
- Crack formation in e.g. 55 - 60 HRC nickel based self fluxing alloys requires pre-heating to about 500 °C; result: distortion of screws with small cross section and undefined position of screw flight edges
- Laser triangulation permits cladding head movement compensating concentricity tolerances (constant working distance)
- Digital image analyses permit precise screw flight edge detection compensating thermally induced screw expansion / shrinkage

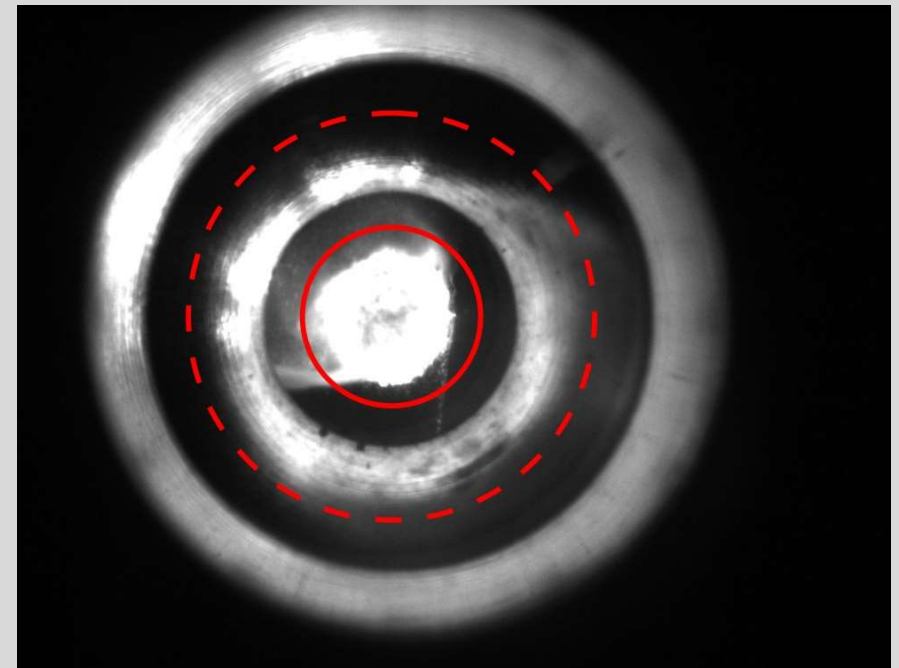
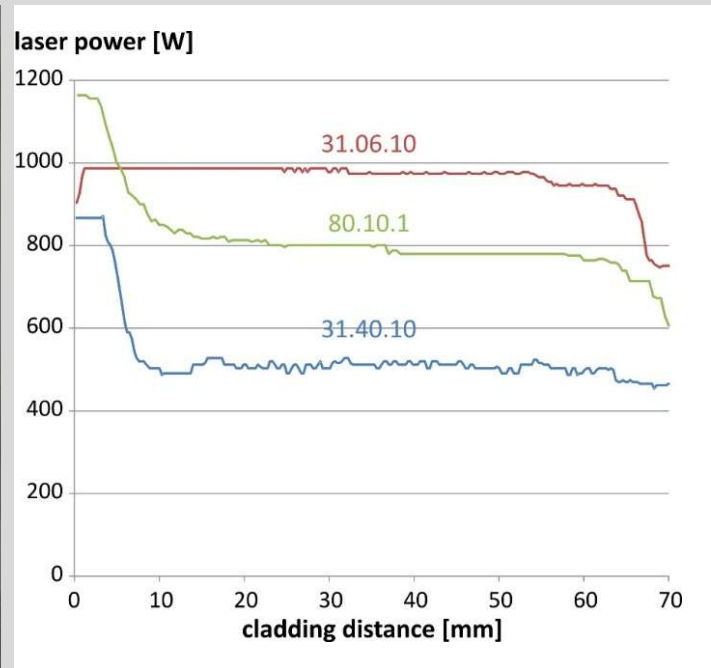
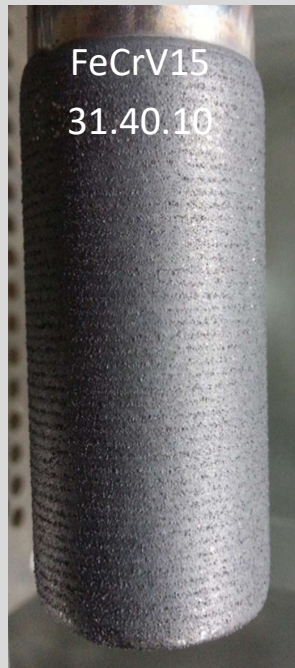
Sensors and Actuators



- Adapted workpiece illumination needed
- CAM data transfer from milling machine to laser cladding machine permits minimal programming effort



Sensors and Actuators



- Melt pool emission intensity is a suitable value for closed-loop control of laser power to compensate temperature increase during cladding on thin walled components
- Reflection intensity inside powder nozzle is a suitable value to detect problems with protective glass / focussing lense problems e.g. due to deposition of vapors or dust particles and immediate shut down prevents their destruction by melting

Kamera aus

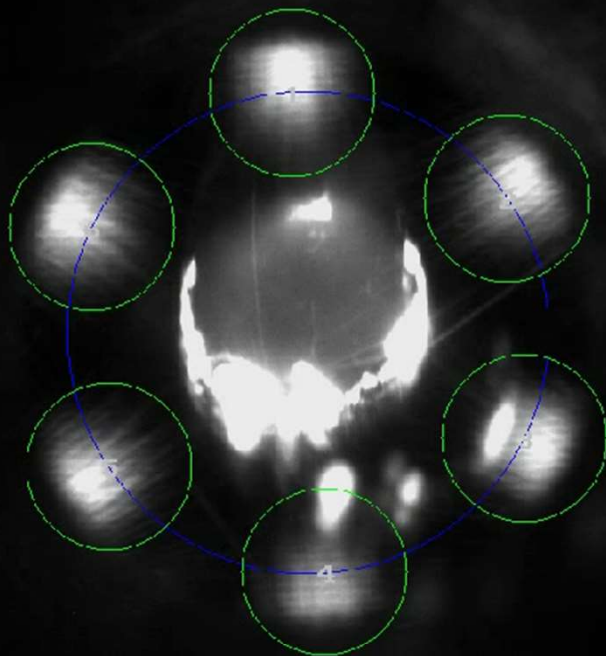
Modus FlowCheck

Anleitung

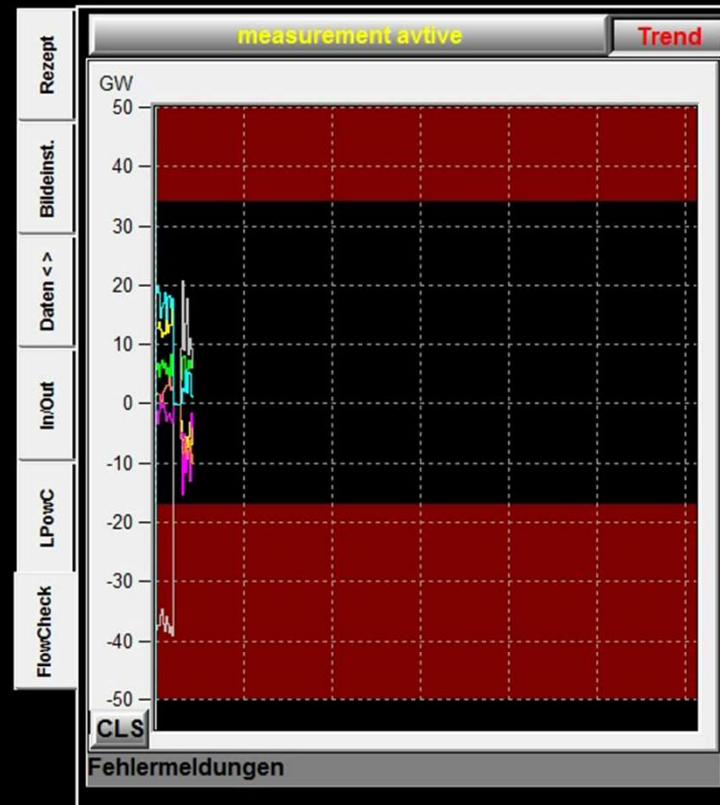


X

x: 0 y:0 val:0



ZM
Messtechnik & Consulting



Prozeß Parameter

Prozeßname: LaserCladding
Bauteil: Dummy

Info: FlowCheck
Überprüfung von 6 Pulverlinien
auf Durchfluß

T

S

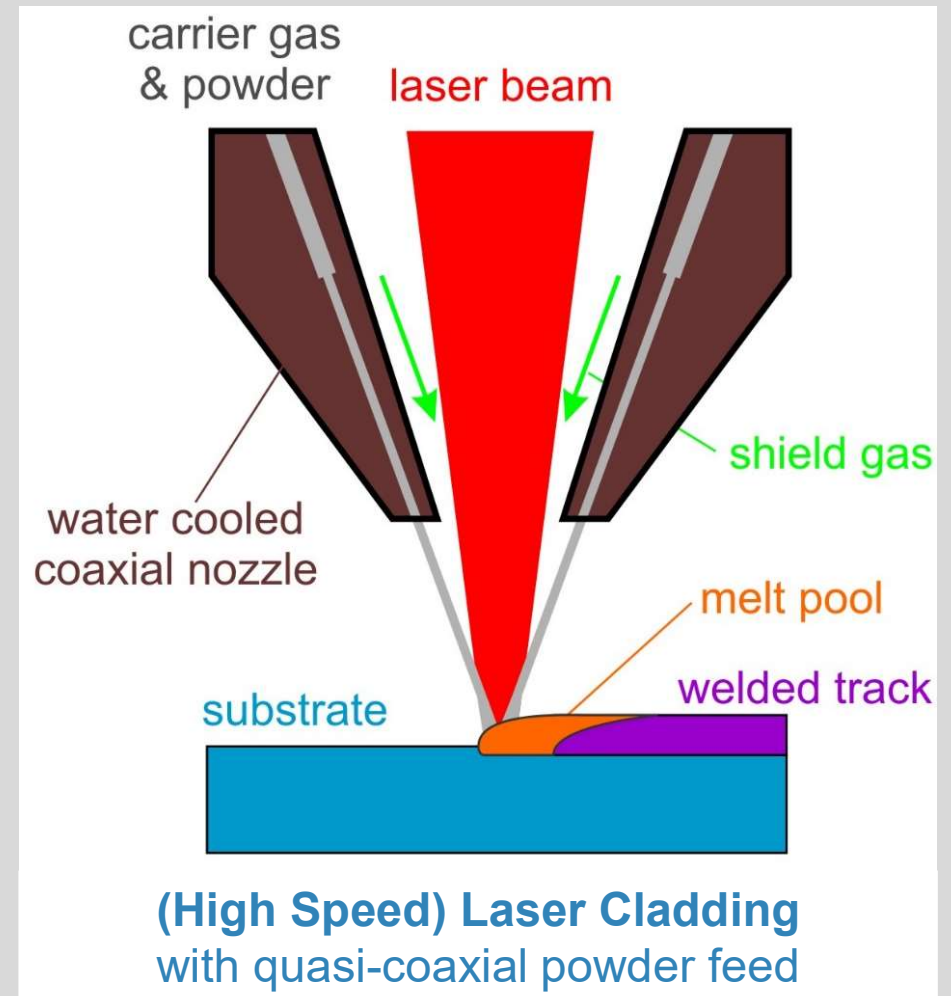
AS



Status: 0
Sub: 0

HSLC Process

- especially designed for cost advantageous coating of large (rotationally symmetric) parts with **gas-tight thin** (< 0.3 mm) claddings
- coverage rates ≥ 1.0 m²/h realizable
- no or only minimum post machining effort
- compared to conventional LC:
 - higher surface speeds
 - smaller track offsets
 - higher laser power density
 - finer powders
 - reduced deposition efficiency



Process Video



Results

Duplex steel, 1.4462



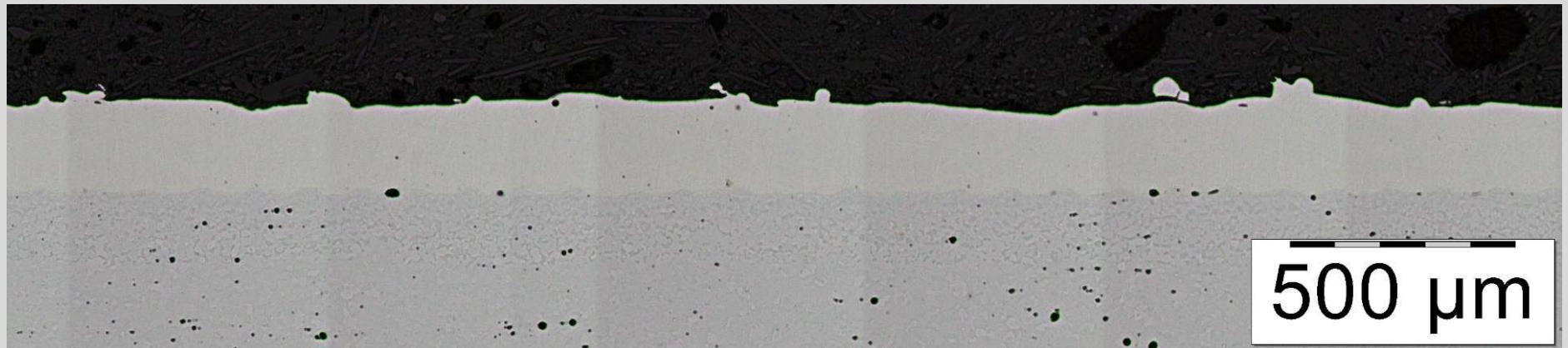
cladding parameters

laser power	6,000	W
surface speed	50	m/min
powder feed rate	54	g/min
preheat temp.	without	



coating properties

coverage rate	1.50	m ² /h
clad thickness (min.)	214	μm
micro hardness	389	HV0.3
deposition efficiency	80	%



Results

FeCrV17



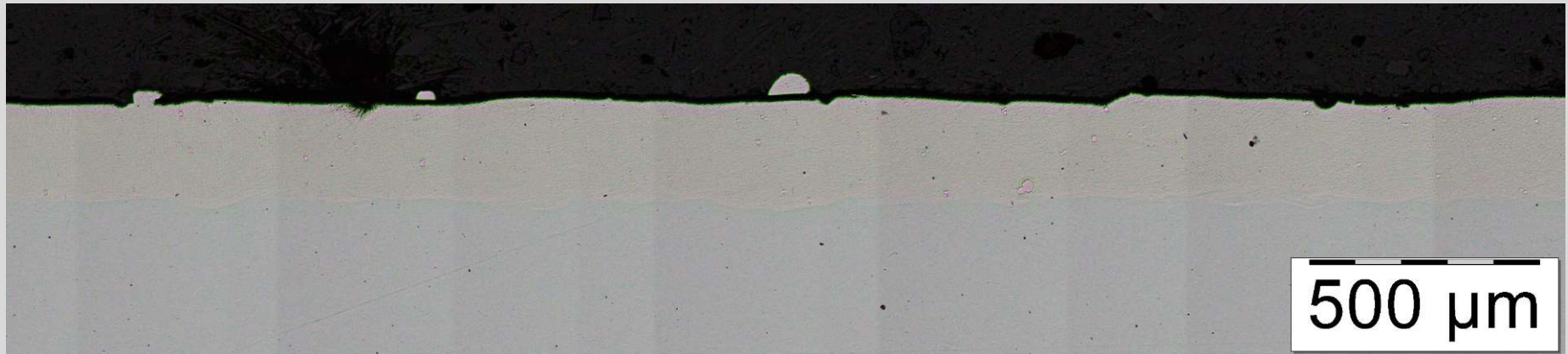
cladding parameters

laser power	3800	W
surface speed	20	m/min
powder feed rate	32	g/min
preheat temp.	200	°C



coating properties

coverage rate	0.96	m ² /h
clad thickness (min.)	190	μm
micro hardness	736	HV0.3
deposition efficiency	76	%



- homogeneous distribution of 1-2 μm sized vanadium carbides
- porosity lower than 1.0%

Applications



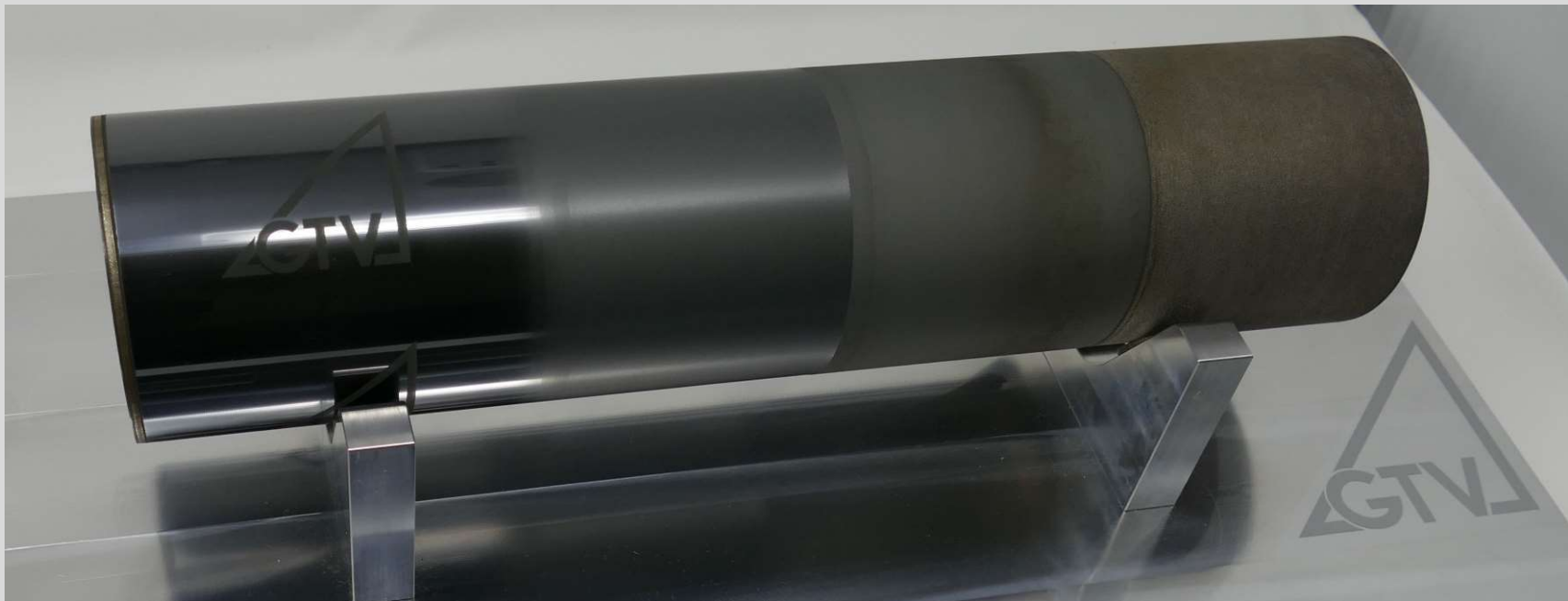
- Corrosion protection / hard chrome replacement
- Duplex steel cladding on a 360 mm diameter, 6,600 mm long tube (7.5 m²), 299 minutes production time



Applications

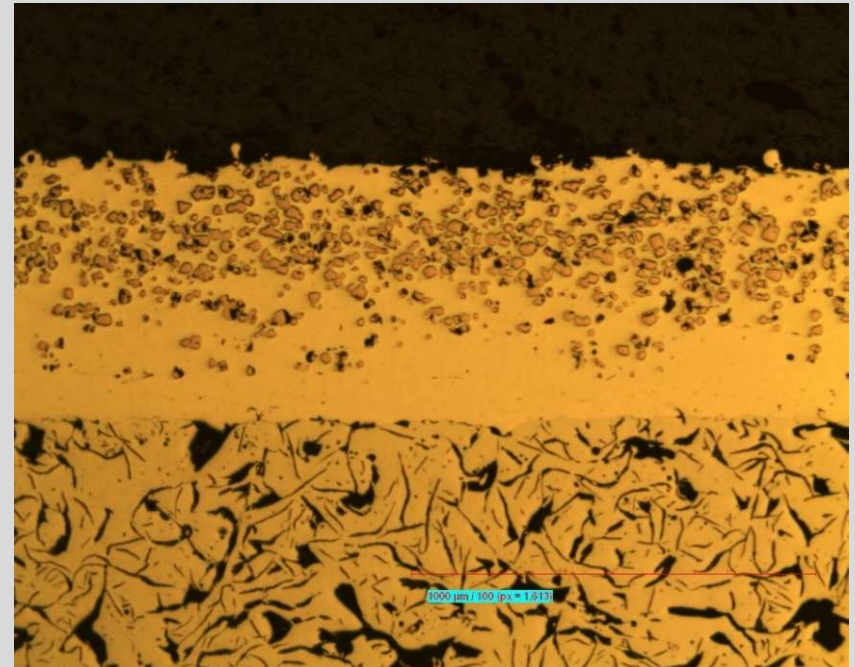


- Gas tight corrosion protective bond coats for APS Cr_2O_3
- No grit blasting or sealing process
- Sufficient bonding between high speed laser cladding and APS Cr_2O_3 to permit grinding, polishing and engraving

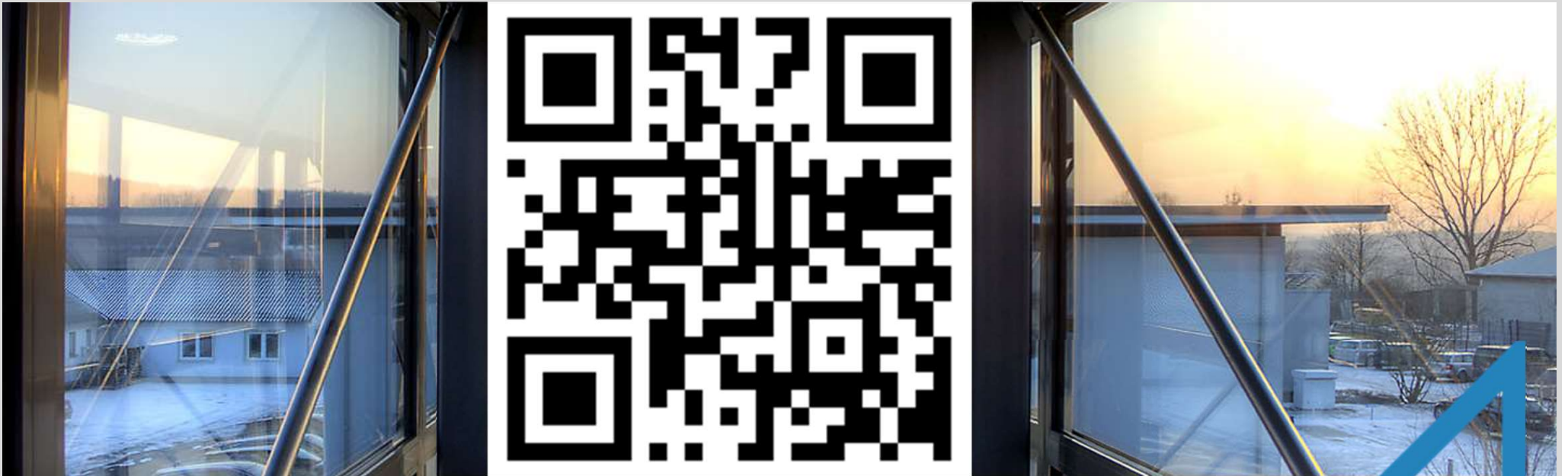


Applications

- Corrosion protection of grey cast iron workpieces
- Functionally graded coatings with metallic matrix and ceramic reinforcement for optimal combined corrosion & wear protection



Thank you very much for your attention!



www.gtv-mbh.com

