

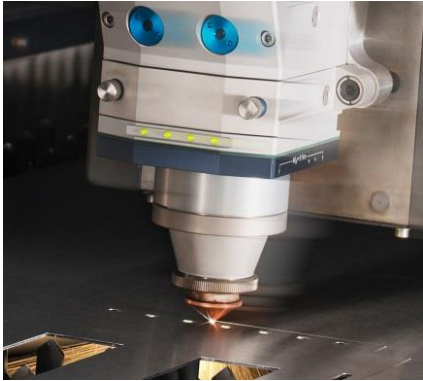


**Laser Metal Deposition and 3D Printing –  
New Sensor Concepts for LMD and  
Innovative System Technology for Additive Processes with Wire**

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# FIVE DIVISIONS

## LASER CUTTING



- Processing heads for laser cutting on flatbed, tube and robot machines
- Processing heads for fine, bevel and high speed cutting
- Process monitoring

## JOINING TECHNOLOGY



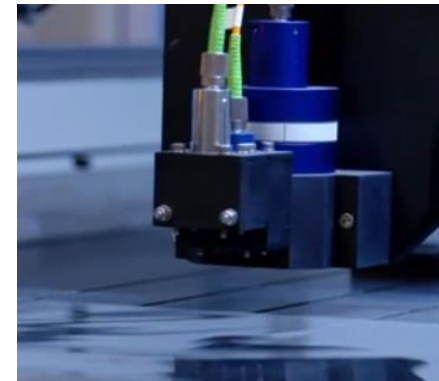
- Processing heads for laser welding and laser cladding
- Monitoring systems for pre, in and post processing

## ALL-IN-LIGHT



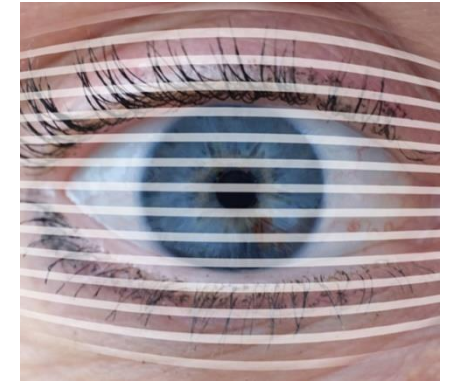
- Complete optical solution from one supplier
- Including laser beam source, cutting head and beam guidance

## MEASUREMENT



- Chromatic confocal sensors
- Interferometric sensors
- 2D Vision Camera
- Point, Line and Multipoint and Scanning

## MEDICAL TECHNOLOGY



- Control for corneal and refractive surgery
- Eye tracking systems

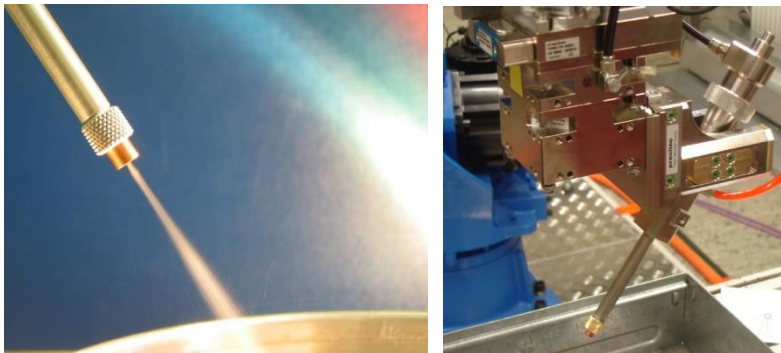
# DED WITH POWDER – STATE OF THE ART

- Different nozzle types flexibly adaptable for various applications

## Off-axis nozzle

- + lean design
- + shielding gas around the powder stream

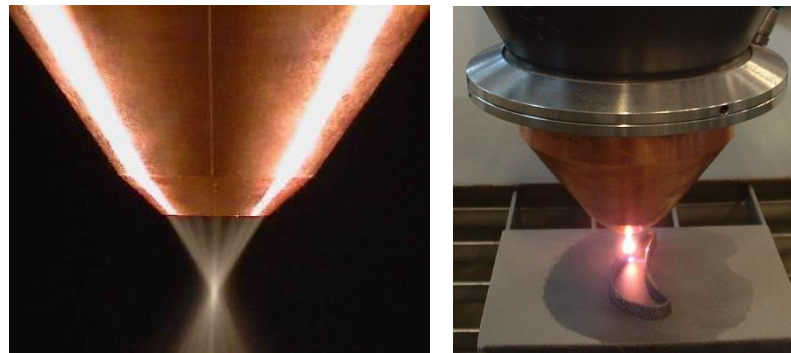
- uni-directional
- larger powder focus



## Ring nozzle

- + homogeneous powder distribution
- + high powder efficiency (spot size ~ 0,8mm)

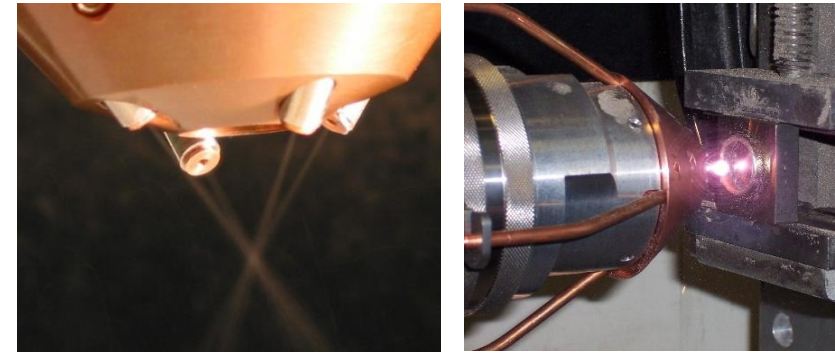
- limitation for working tilted positions



## Multi beam nozzle

- + easy work in horizontal position
- + stands higher laser power

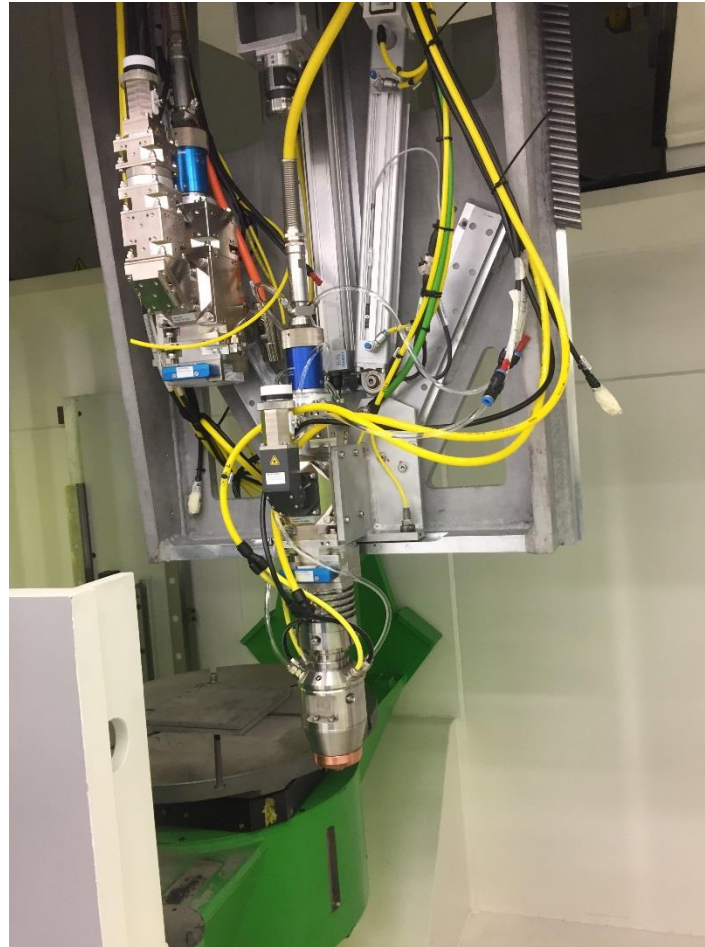
- worse powder distribution
- worse powder efficiency (spot size ~ 3mm)





# DED WITH POWDER YC52 AND YC30 PROCESSING HEAD

- Applications Ring nozzle



- Laser System: IPG 2kW Fiber Laser
- Build volume: 1200x800x800
- Control: Siemens 840D
- Powder distributor: 1 bowl (1.5L)
- Upgrade: 5 bowls of 1.5L or 3L
- Controlled atmosphere with purification system
- Renishaw probe
- Milling spindle 2.5kW – 24k RPM



# DED WITH POWDER YC52 AND YC30 PROCESSING HEAD

- Applications Ring nozzle



Aerospace structural part

- Inside diameter: 590mm
- Outside parameter: 670mm
- Height: 400mm
- Weight of powder: 35kg
- Material: TA6V
- Construction time: 110 hours

IREPA LASER

PRECITEC

# JOINT R&D PROJECTS – SCIENCE & INDUSTRY HAND-IN-HAND

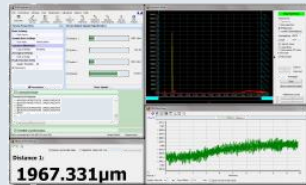
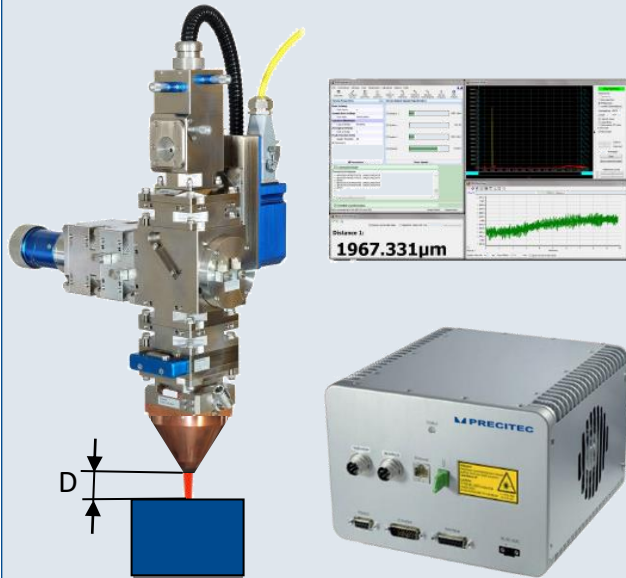
## LAYER THICKNESS CONTROL - ARCHITECTURE



PRECITEC

### IDM Sensor

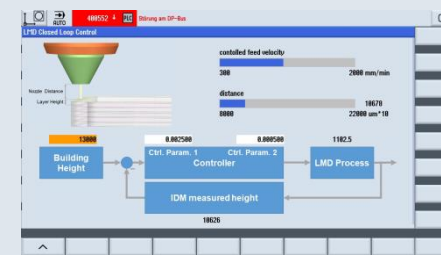
- In process measurement of nozzle distance
- Integrable in various LMD Heads



### SIEMENS Machine Control

#### HMI-Module

Sinumerik  
840D sl

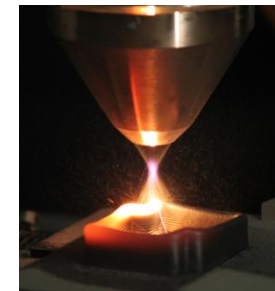


#### Sensor Interface

ET 200 SP



### Layer Thickness Control



Uncontrolled,  
out of focus process

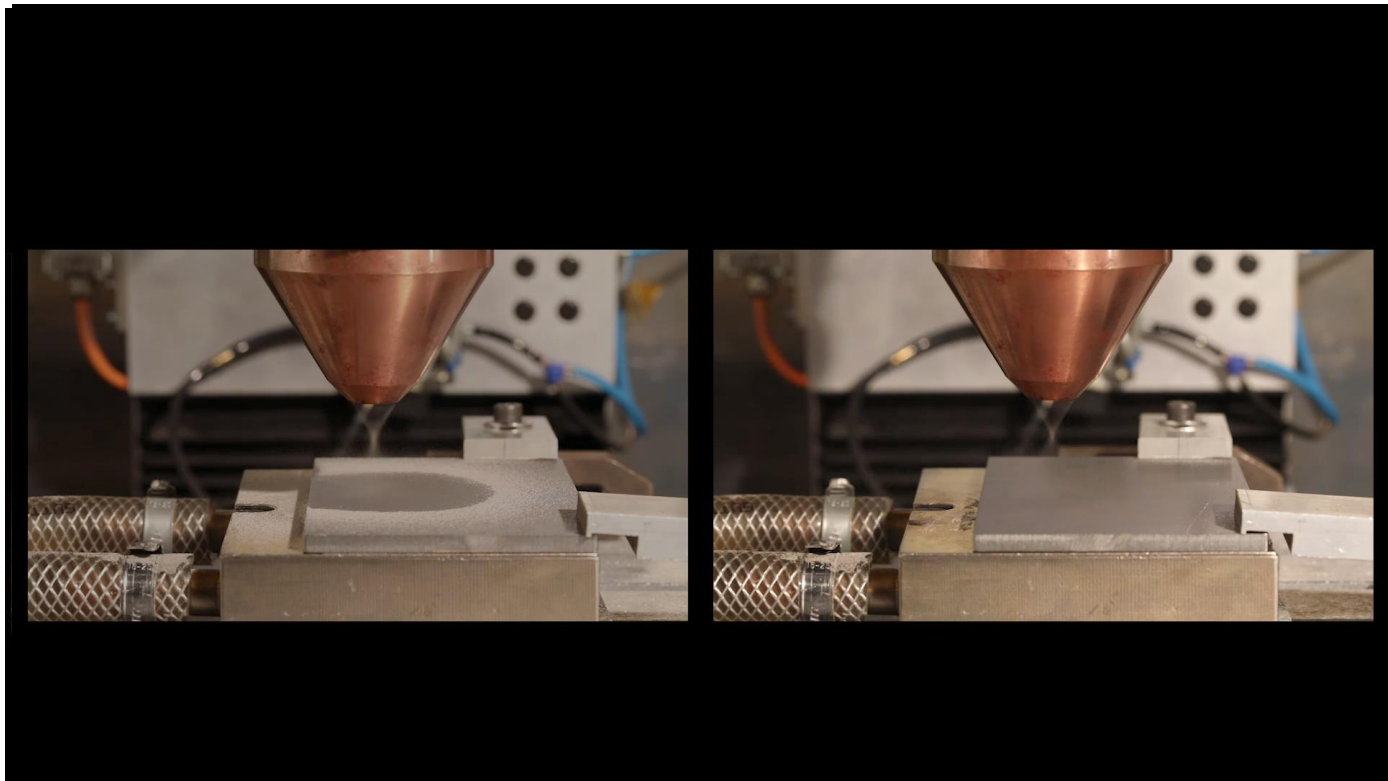


Controlled,  
in focus process

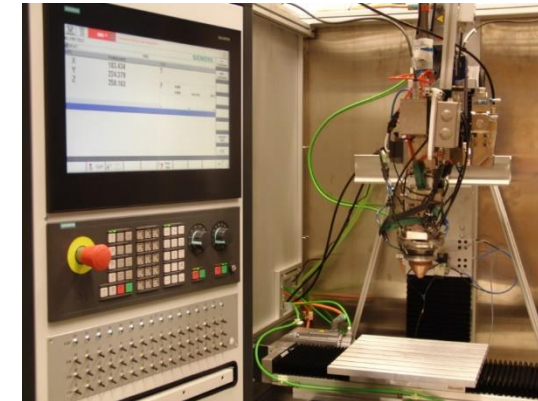


# CLOSED LOOP MOTION CONTROL

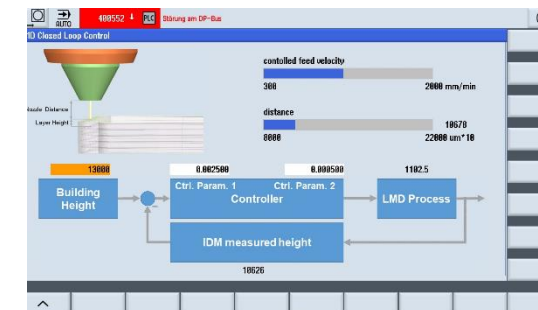
## DED PROCESS WITH PRECITEC IDM (OCT) SYSTEM



Movie DED Closed Loop Motion Control

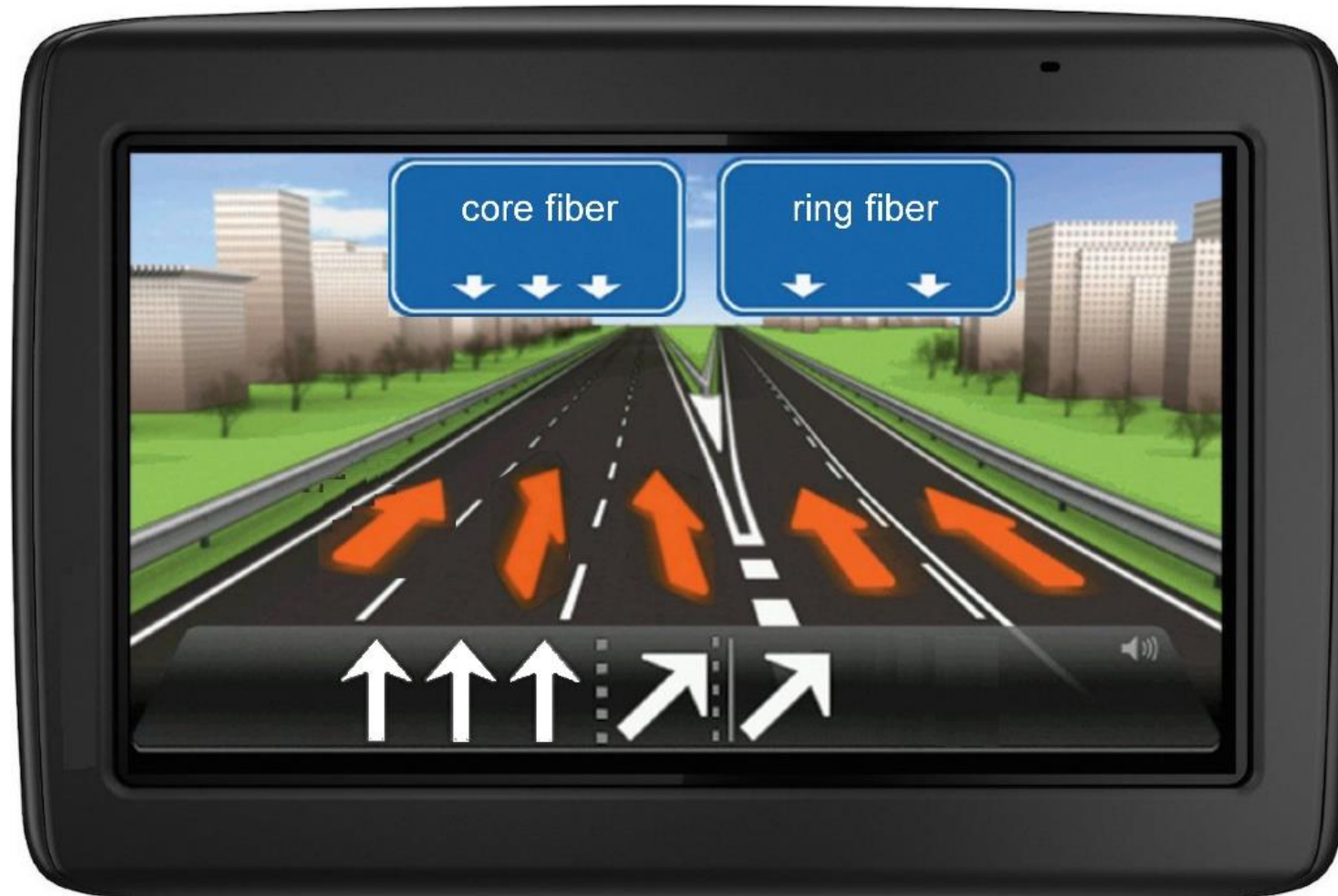


3 axes test setup with Sinumerik 840D sl and Precitec Head and IDM System



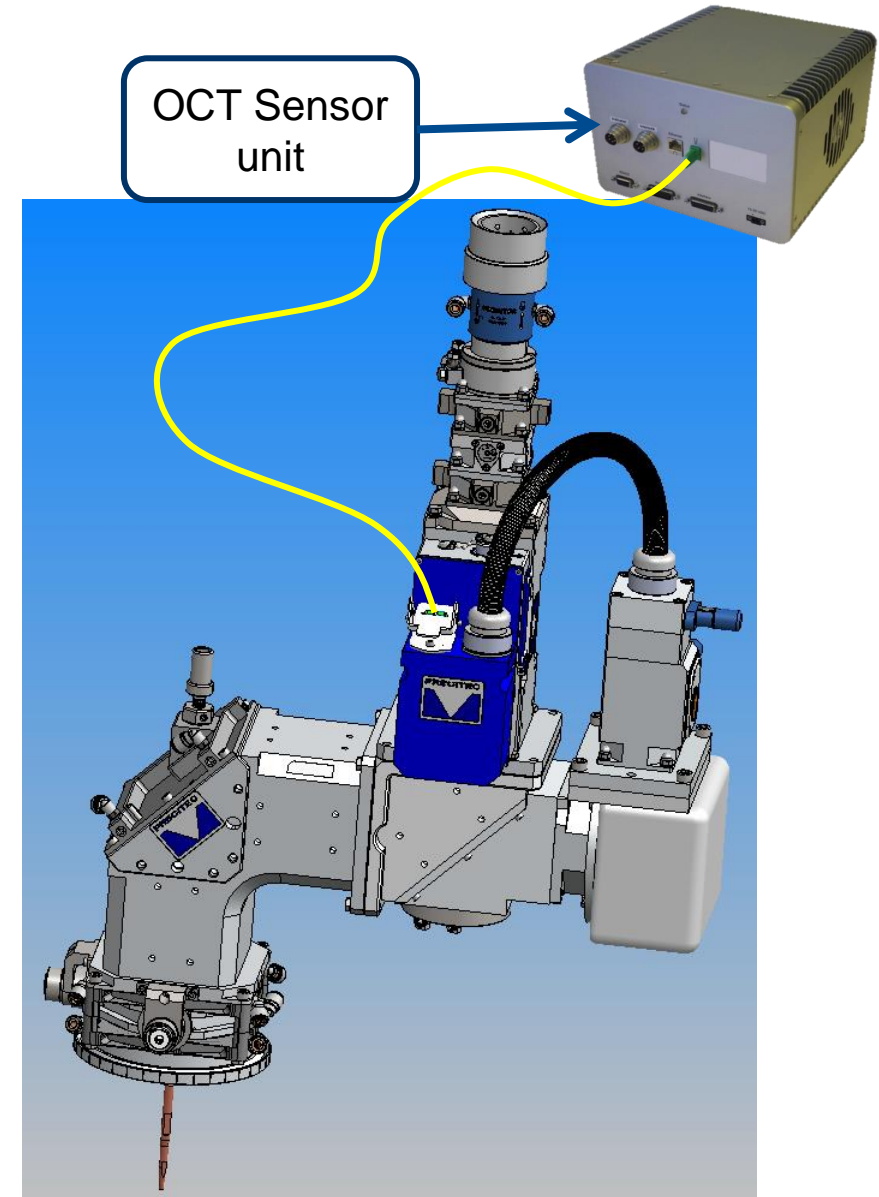
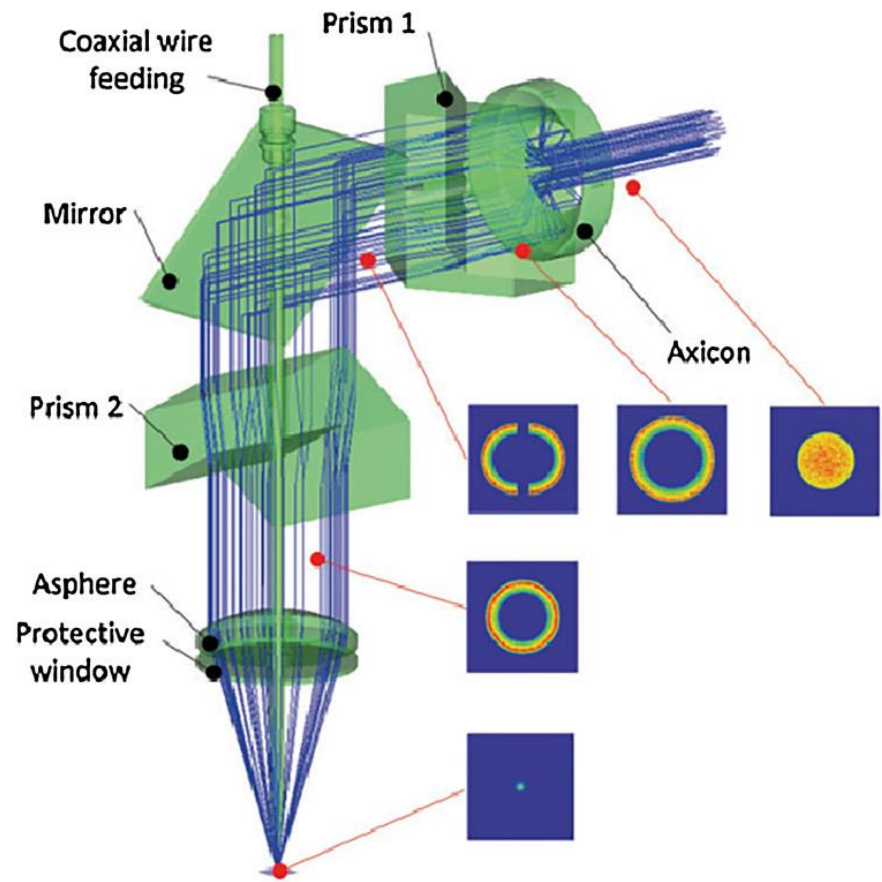
Customized Sinumerik Operate Display

# GPS SYSTEM FOR PHOTONS – THE FUTURE OF MATERIALS PROCESSING



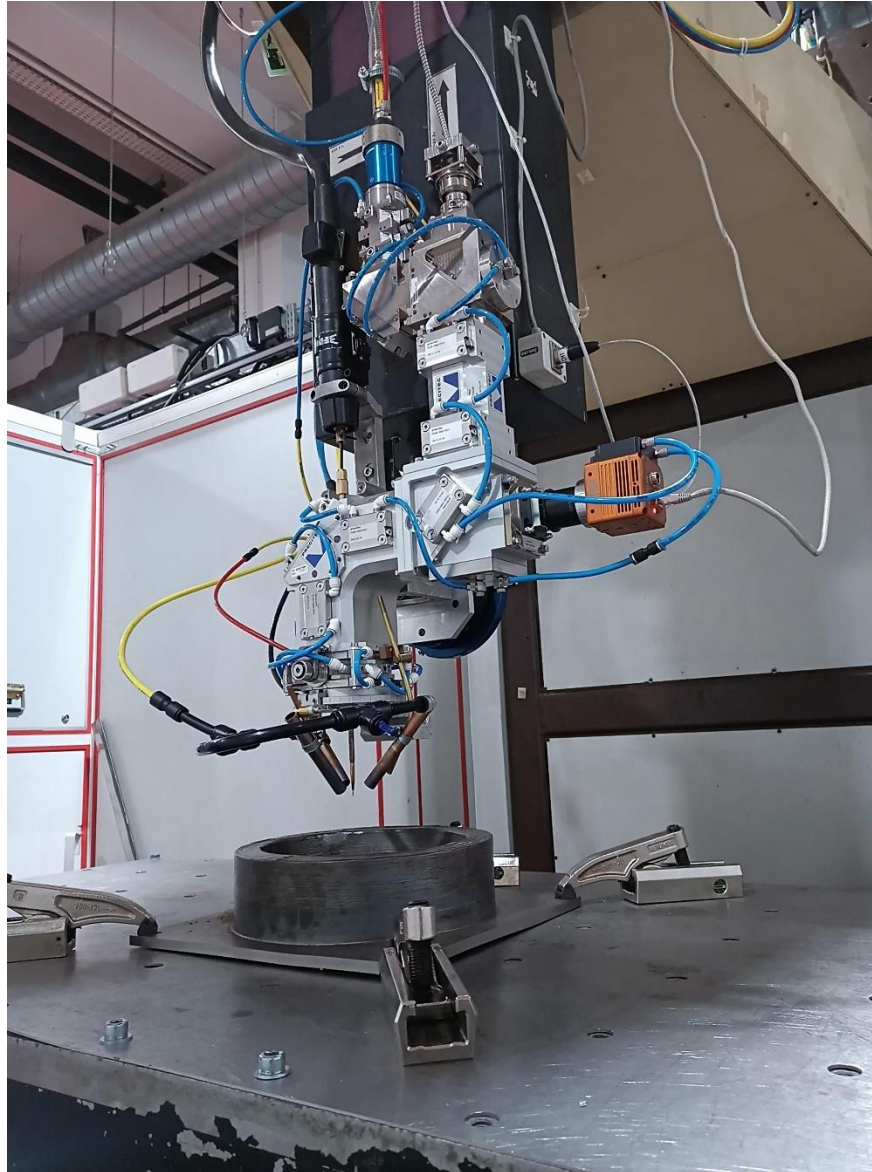


# DED WITH WIRE – A NEW APPROACH



# LMD WITH WIRE – PRECITEC COAXPRINTER

## APPLICATION EXAMPLES



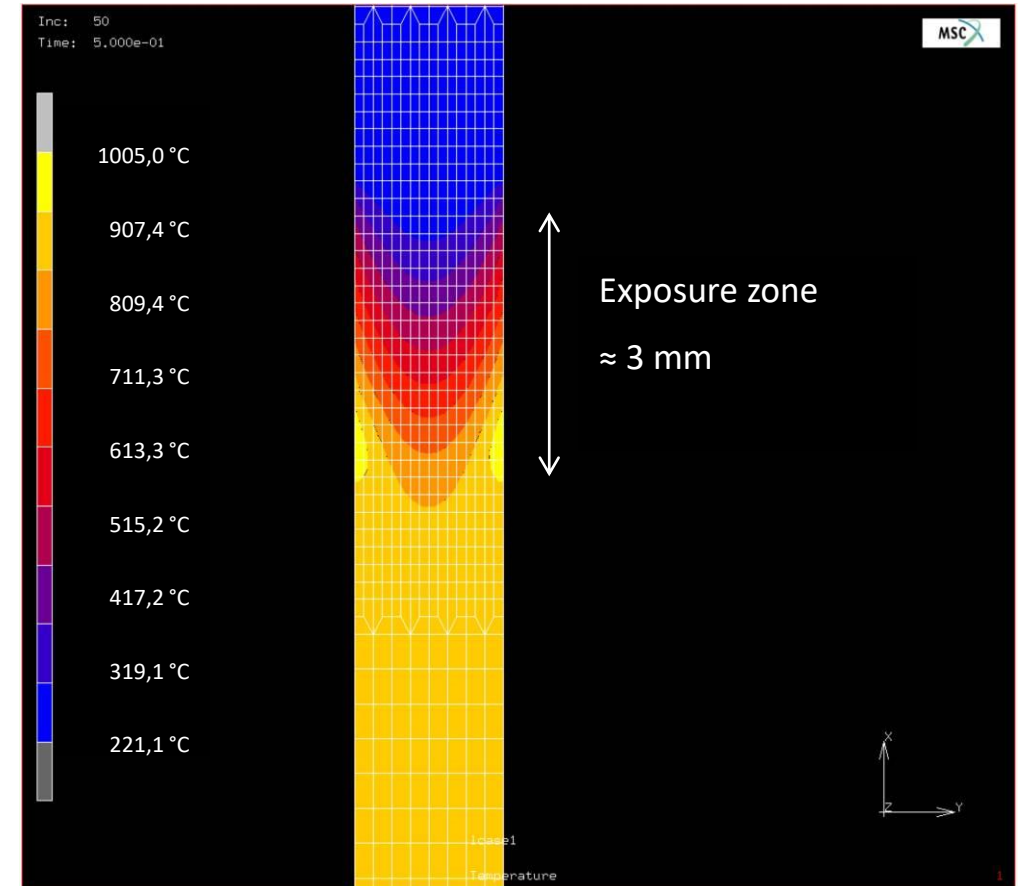
# DED WITH WIRE – A DEEPER LOOK INTO THE BEAM PATH

## TEMPERATURE DISTRIBUTION IN THE WIRE – FEM ANALYSIS

- laser power 3 kW
- exposure zone  $\approx 3\text{mm}$
- wire speed 5 m/min.
- wire diameter 1.6 mm

Result of the FEM analysis:

The wire is hot before hitting the workpiece surface





# DED WITH WIRE – PRECITEC COAXPRINTER

## APPLICATION EXAMPLES

Stainless steel  
(e.g. 316)

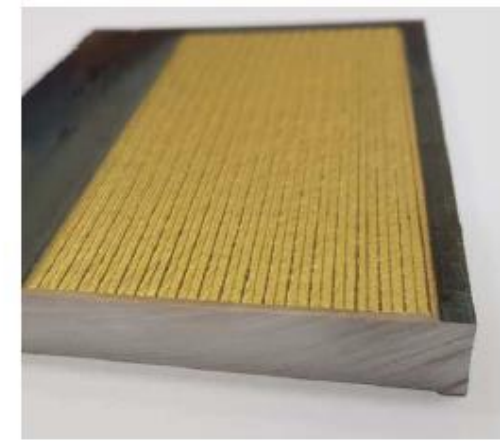
Aluminium  
(e.g. Al5356)

Titanium  
(e.g. TA6V)

Inconel  
(e.g. 718)

Flux-cored wire  
(e.g. Durolite 21)

Bronze  
(e.g. CuAl8)



# DED WITH WIRE – PRECITEC COAXPRINTER

## APPLICATION EXAMPLES



- Material SS316L
- 1,5-1,8 kW
- 1m/min robot/machine speed
- 1,2m/min wire feed rate
- 0,4 to 0,6 mm single track height
- Deposition rate: 470 g/h (60 cm<sup>3</sup>/h)





# DED WITH WIRE – PRECITEC COAXPRINTER

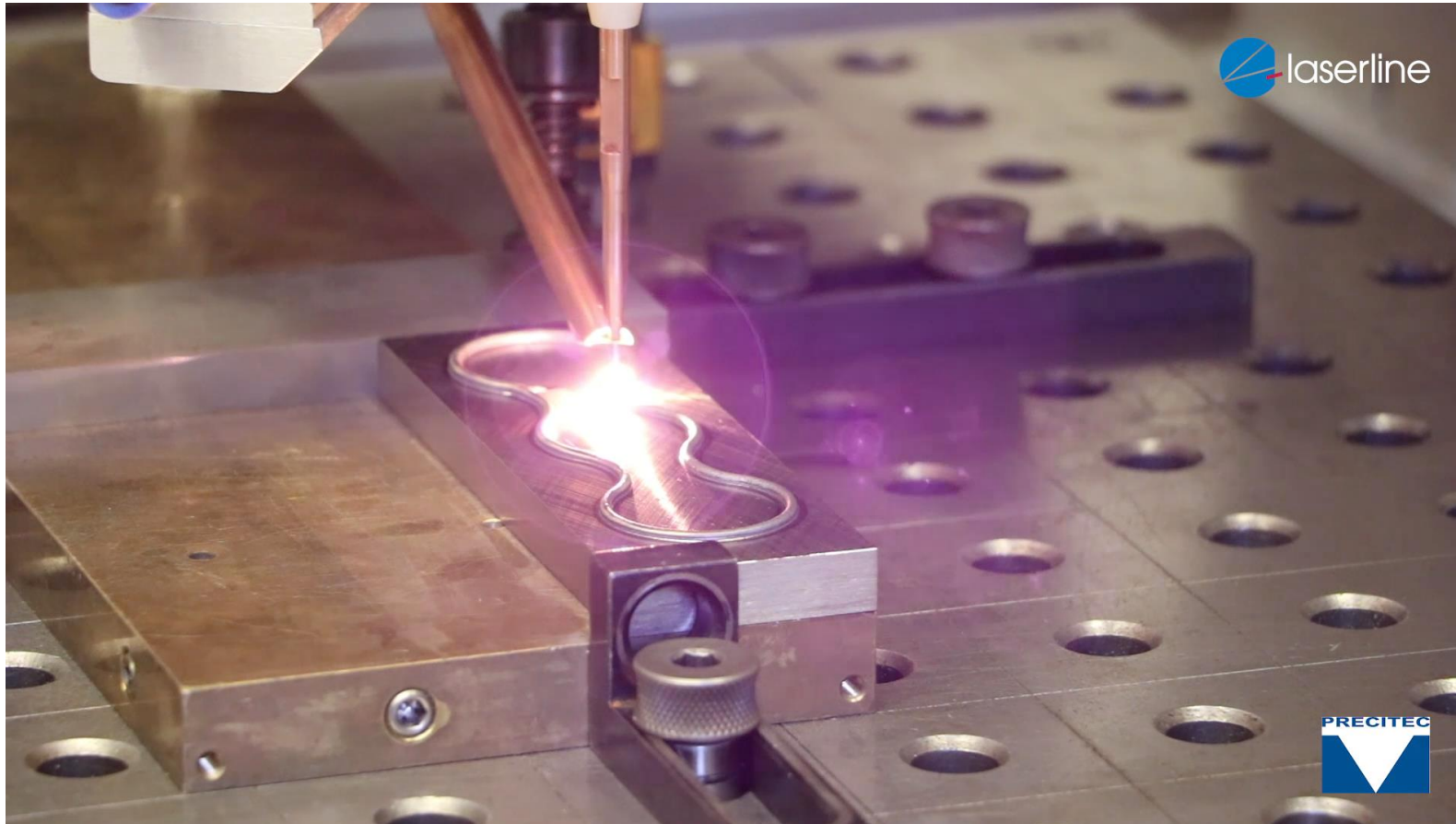
## APPLICATION EXAMPLES





# DED WITH WIRE – PRECITEC COAXPRINTER

LASER CLADDING: VIDEO



# TAKE AWAY MESSAGES

- **Machine Vision**
  - OCT is the only real measuring device in DED
  - OCT enables closed-loop processes also in DED with powder and wire
- **Application specific intensity distribution**
  - Coaxial material (powder and wire) support is the only chance for automated production
  - The CoaxPrinter by Precitec is the most efficient robot compatible solution for 3D printing
- **Flexibility**
  - Changing wire is a question of few minutes
  - No cleaning needed because of 100% material use
- **Collaboration with machine builders and researchers extends the range of use**

# WHAT CAN YOU DO FOR THEM AND WHAT CAN THEY DO FOR YOU

- **We offer the most easiest to handle 3D printing device for**
  - **build up of near net shape geometries**
  - **build up of functional assemblies**
  
- **We need**
  - **to raise the confidence, that DED wire is an alternative for 3D printing**
  - **more potential applications e.g. hybrid**





## Any questions?

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