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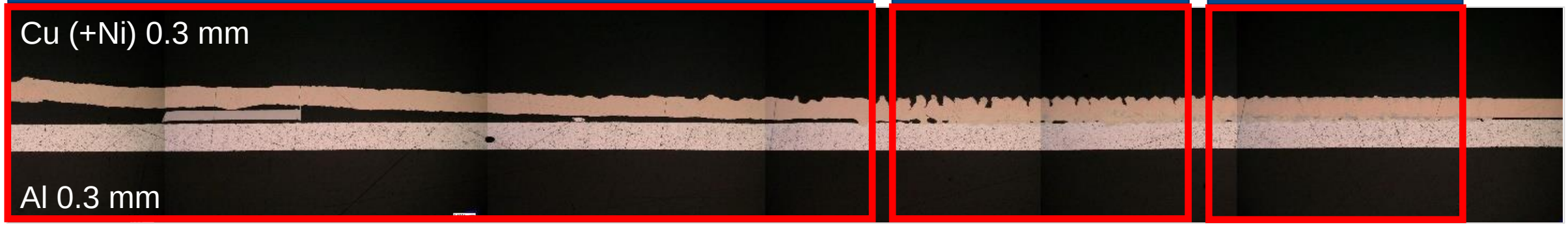
Going Green - Laser Welding and Sensor Technology Driving E-Mobility
Munich, April 26, 2022

Dr.-Ing. Jens Reiser
Sales & Innovation E-Mobility

LASER WELDING MONITOR (LWM): FALSE FRIEND

Gap not bridged → False friend	Gap bridged	OK weld



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INTRODUCTION

- Headquarters:
  - Gaggenau, Germany
  - Neu-Isenburg, Germany
- Independent family-owned enterprise
- Employees: 750 worldwide
  215 in China
  15 in USA
- Turnover 2021: 160 million €
- Patents: > 245

Cutting, welding and optical measurement

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INTRODUCTION

Gaggenau, Neu-Isenburg, Neftenbach, Châteauneuf-le-Rouge, Wixom, Beijing, Shanghai, Shenzhen, Hongkong, Tokio, Seoul

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E-MOBILITY MARKET: APPLICATIONS

Batteries

- Pouch cells
- Cylindric cells
- Prismatic cells

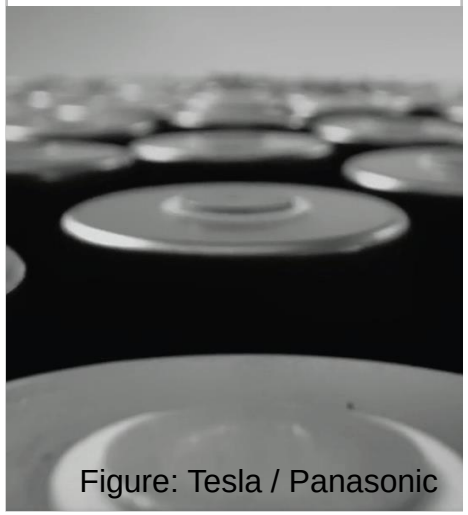
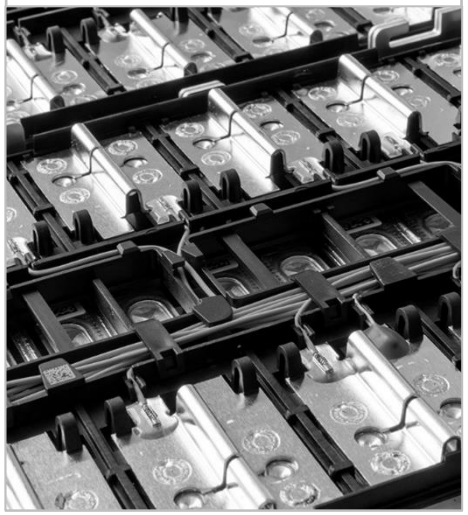


Figure: Tesla / Panasonic

Modules

- Contacting
- Bus bar welding



Electronics

- Power train
- Inverter

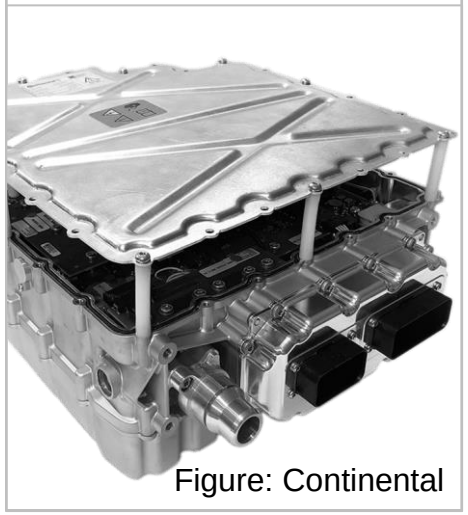


Figure: Continental

Hairpins

- Power train
- Stator

Figure: KIT

Fuel cells

- Welding of bipolar plates
- > 400 m, tight

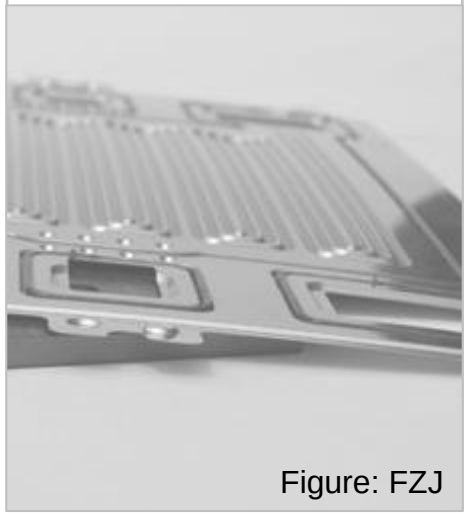


Figure: FZJ

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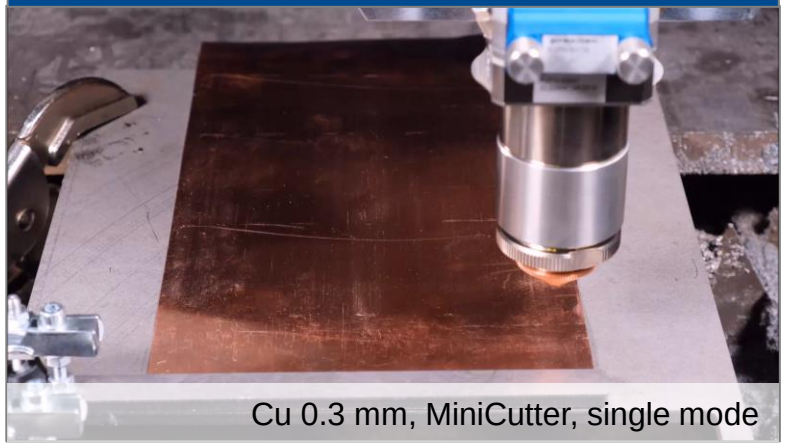
E-MOBILITY MARKET: OUR PRODUCTS

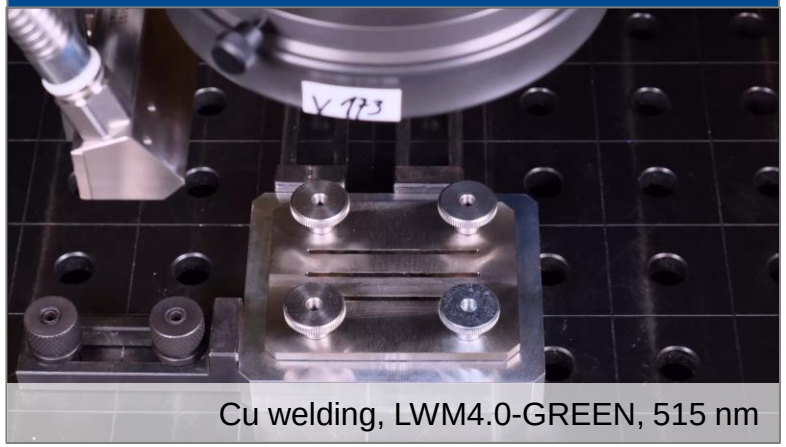
Cutting



Cu 0.3 mm, MiniCutter, single mode

- Cell production: Cutting of collector foils (Cu 10 um, Al 30 um)
- Fuel cells: Cutting of bipolar plates (SS 0.1 mm)

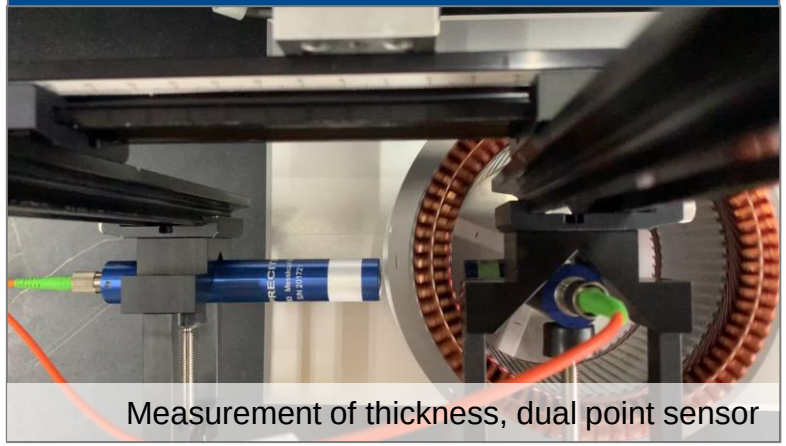
Welding



Cu welding, LWM4.0-GREEN, 515 nm

- Cell production: Welding collectors to tap
- High-voltage electronics: welding of Cu sheets

Optical measurement



Measurement of thickness, dual point sensor

- Cell production: Topology after calendaring
- Hairpins: Thickness of coating before stripping

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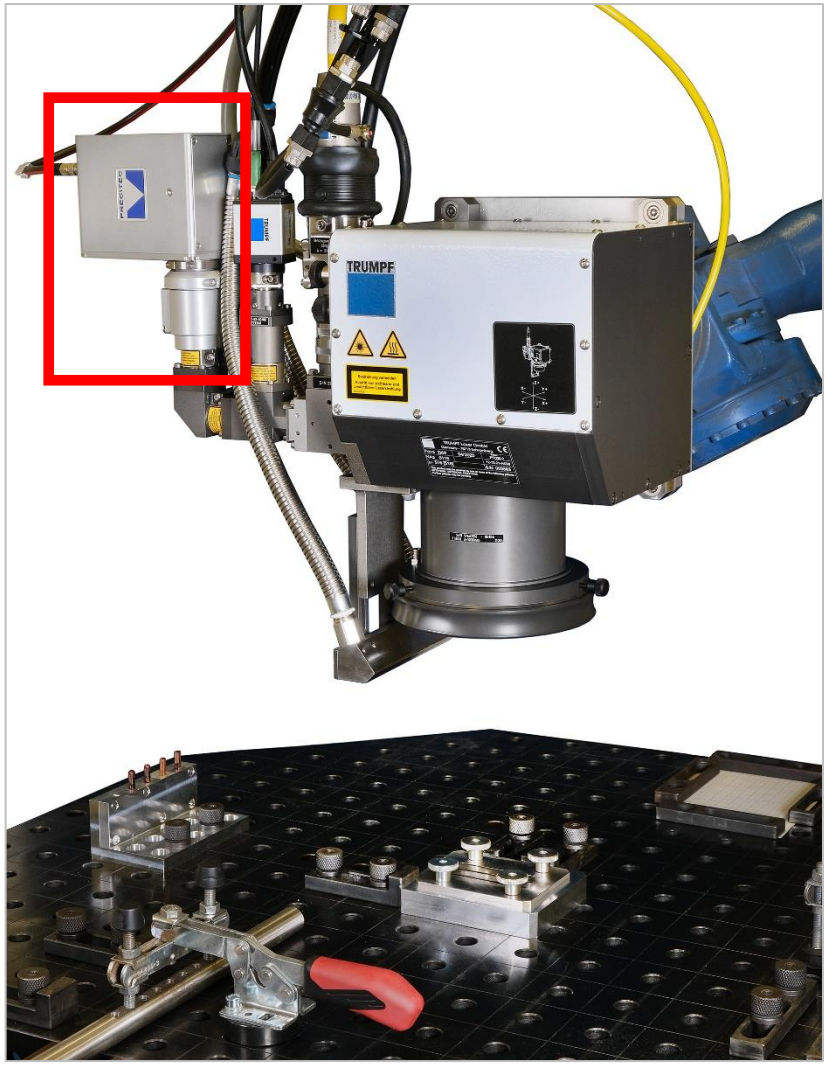
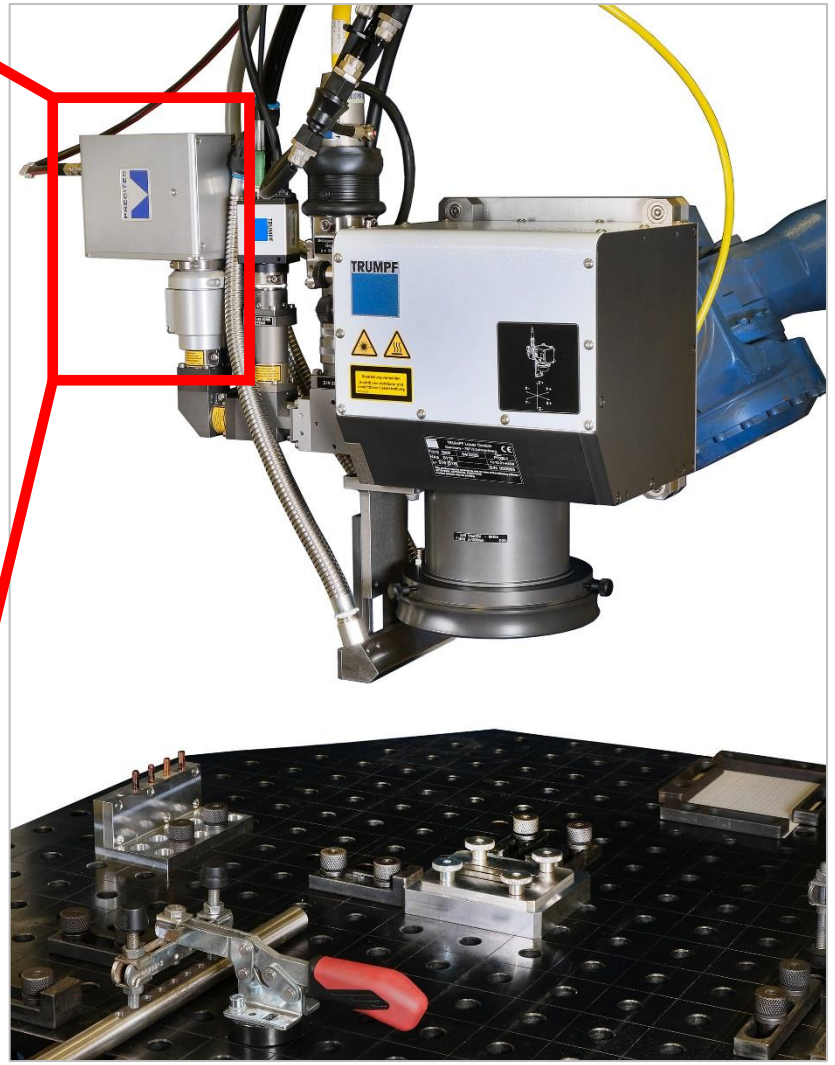
LASER WELDING MONITOR (LWM)



LASER WELDING MONITOR (LWM)

New sensor: LWM4.0



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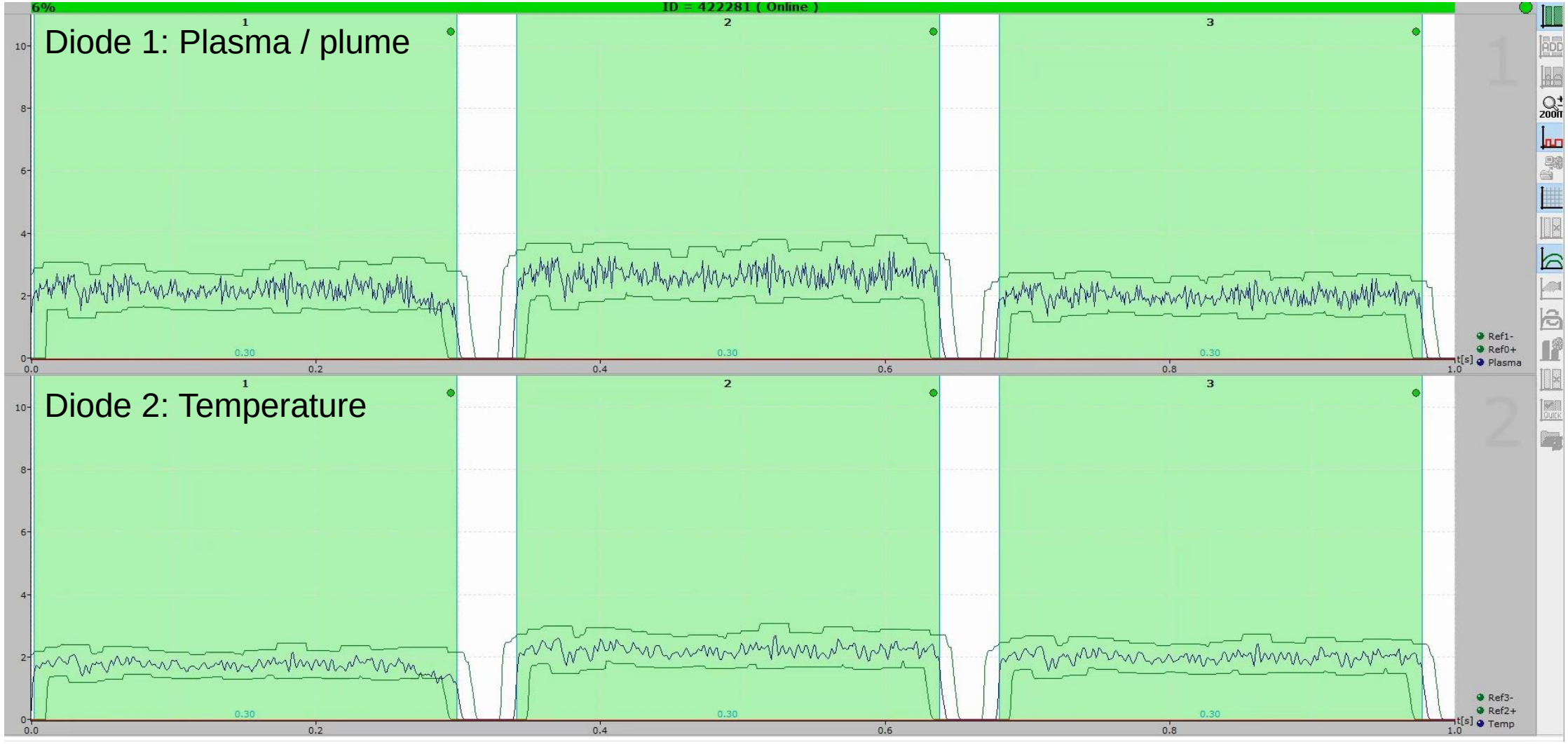
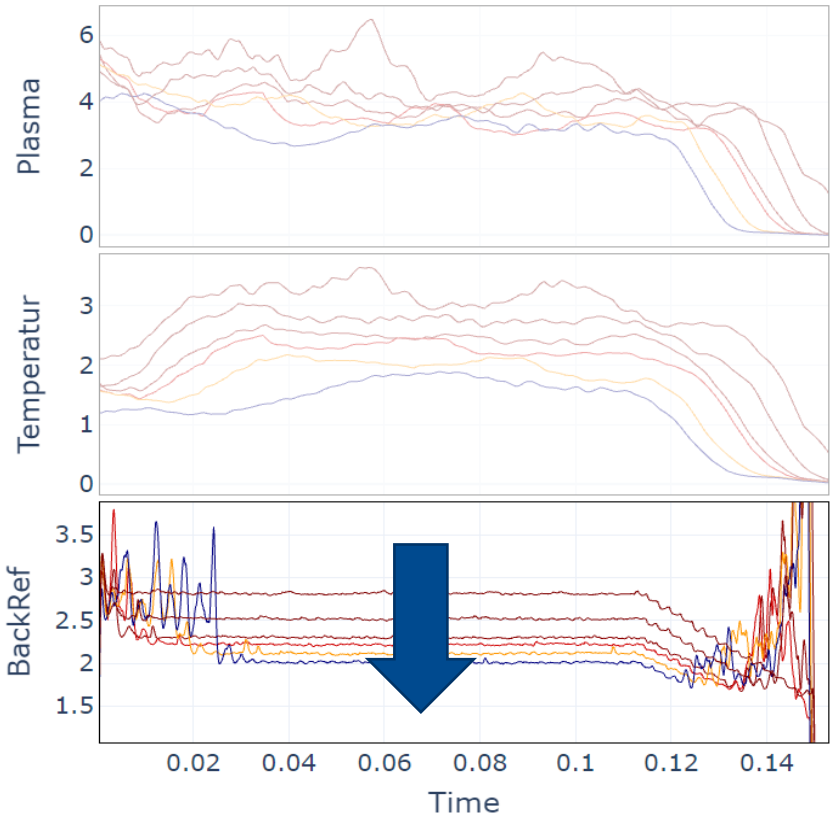


LASER WELDING MONITOR (LWM)

Variation of laser power (LP)

Variation of focal position (FP)

Variation of gap



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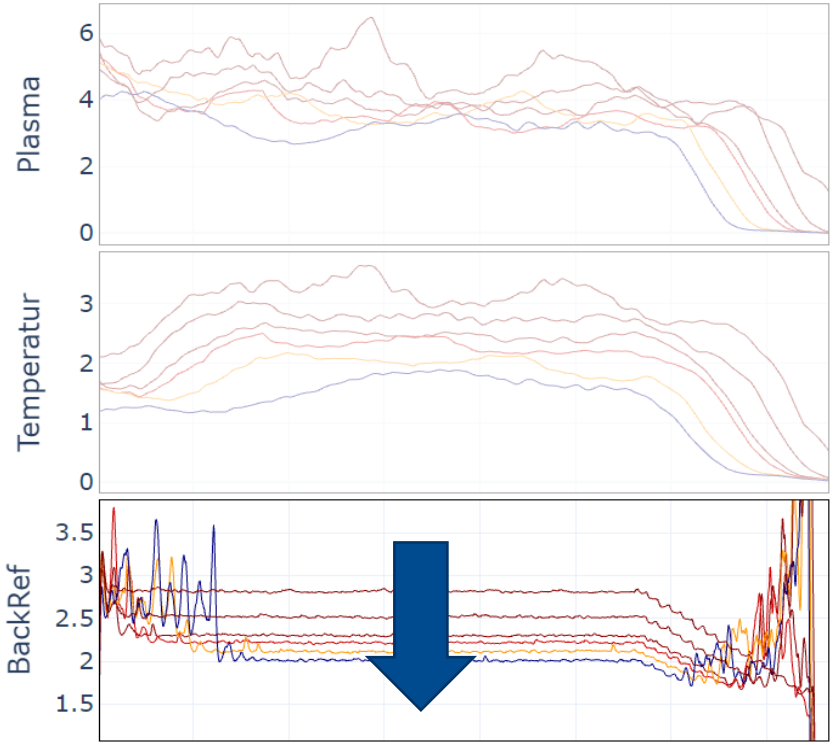
LASER WELDING MONITOR (LWM)

Variation of laser power (LP)



Laser power scales with welding depth

Variation of focal position (FP)

Variation of gap

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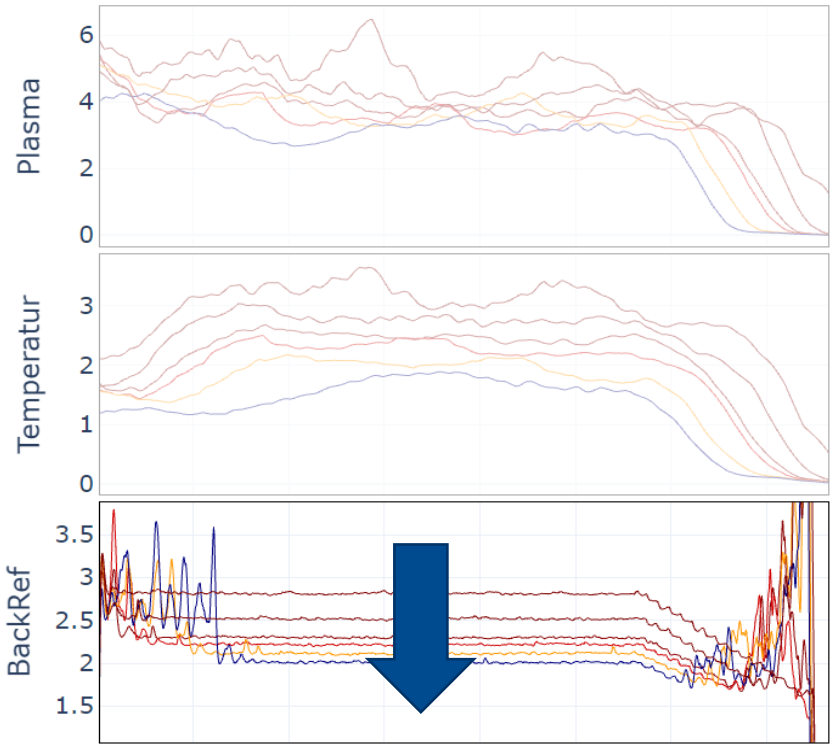
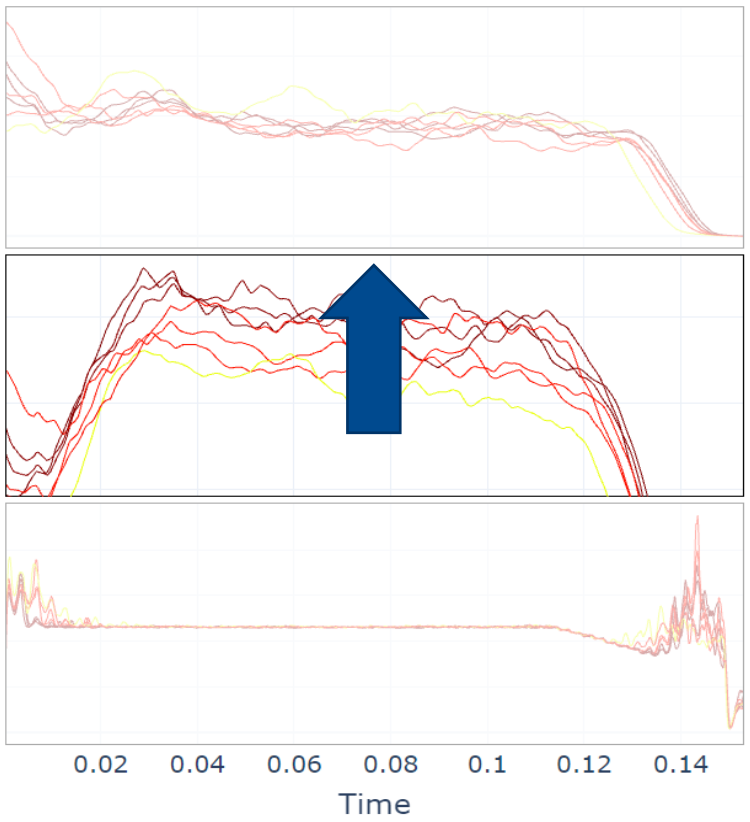
LASER WELDING MONITOR (LWM)

Variation of laser power (LP)



Laser power scales with welding depth

Variation of focal position (FP)



Variation of gap

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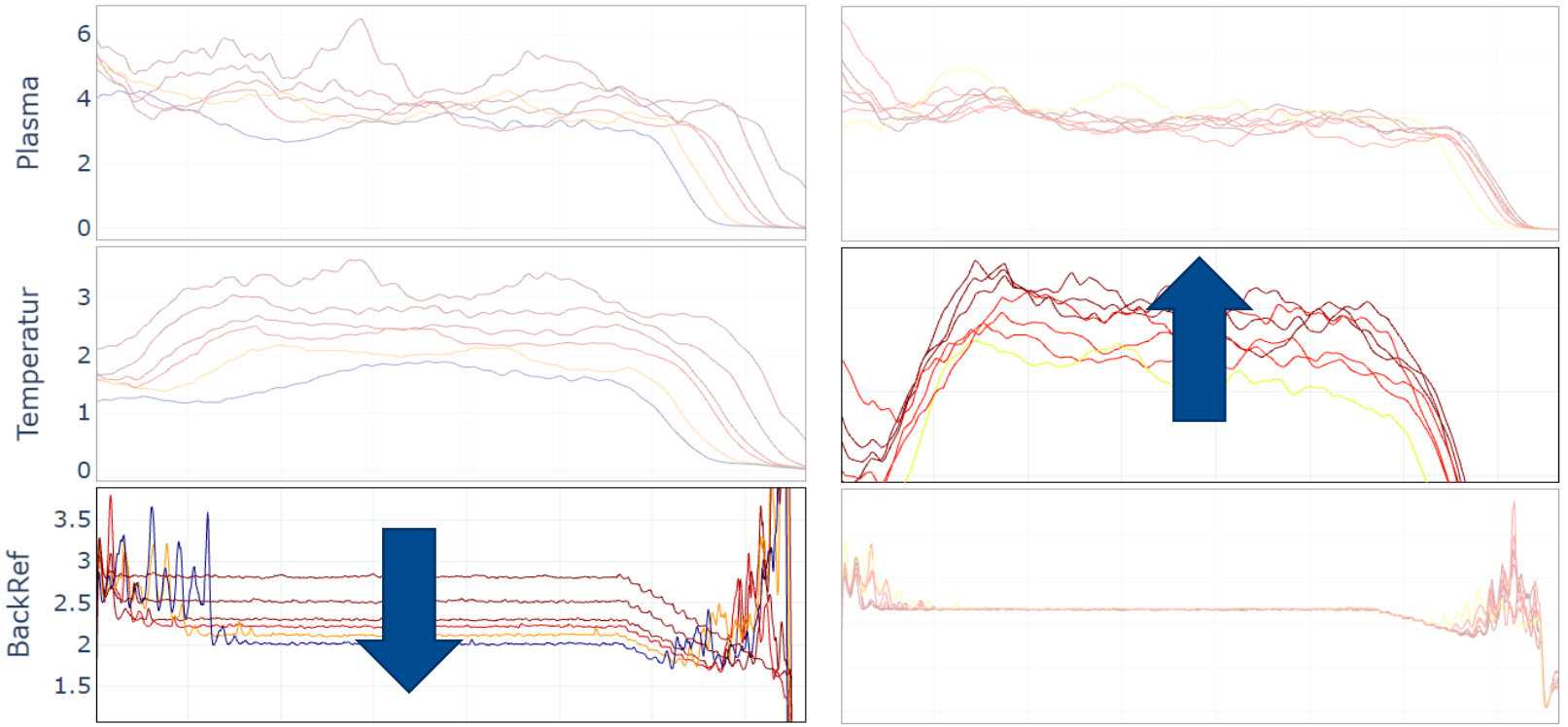
LASER WELDING MONITOR (LWM)

Variation of laser power (LP)	Variation of focal position (FP)	Variation of gap



Laser power scales with welding depth	Deterioration of protective window can be detected

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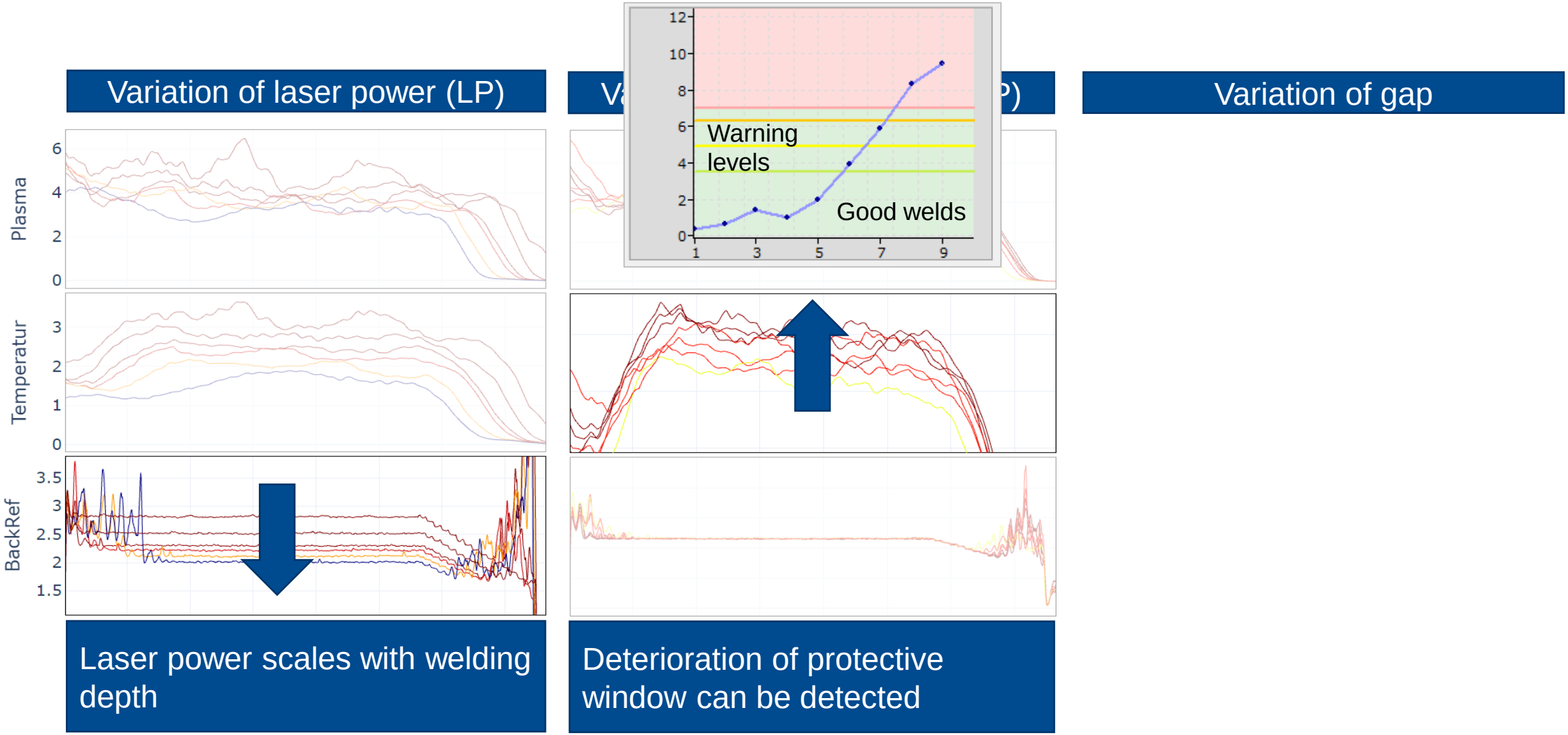
LASER WELDING MONITOR (LWM)



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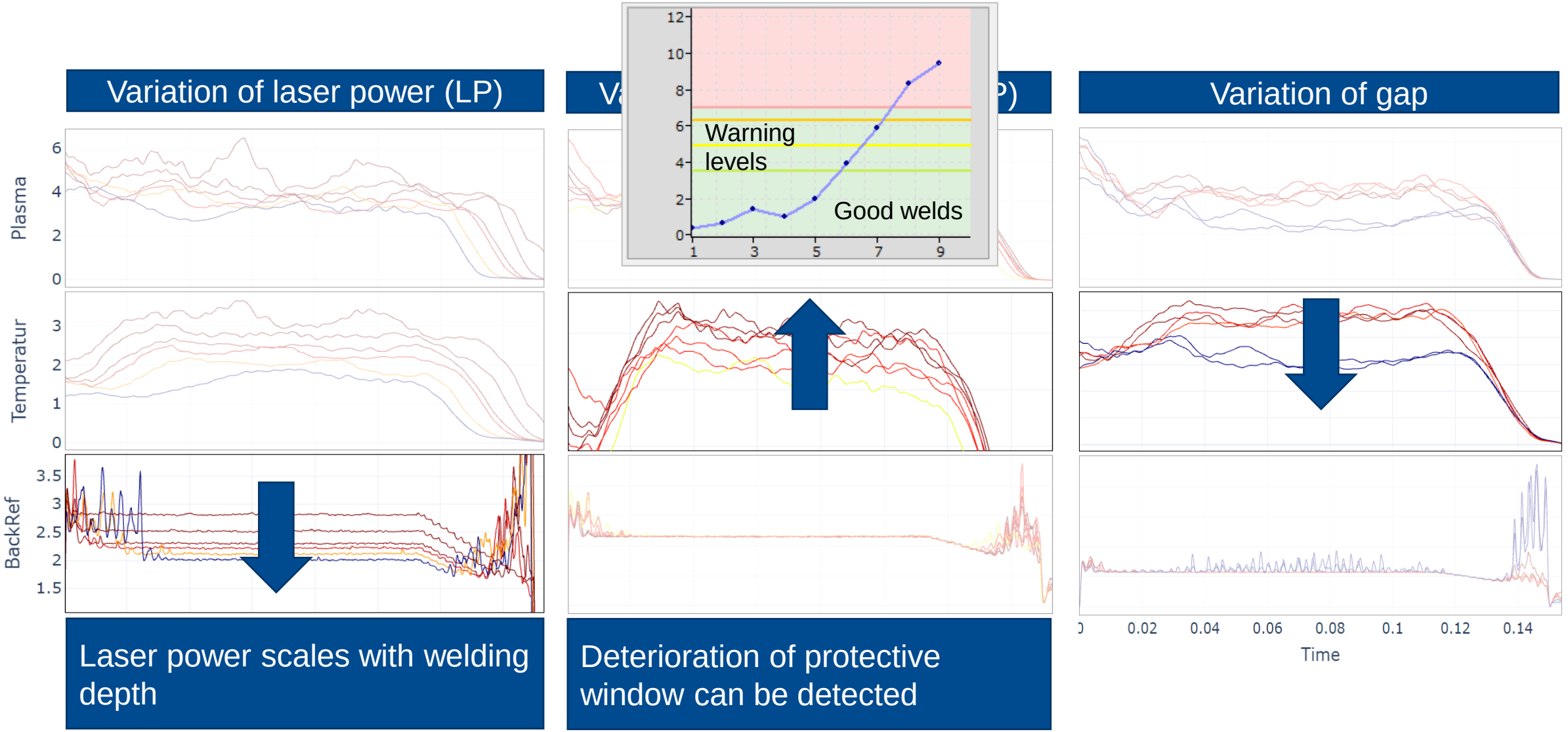

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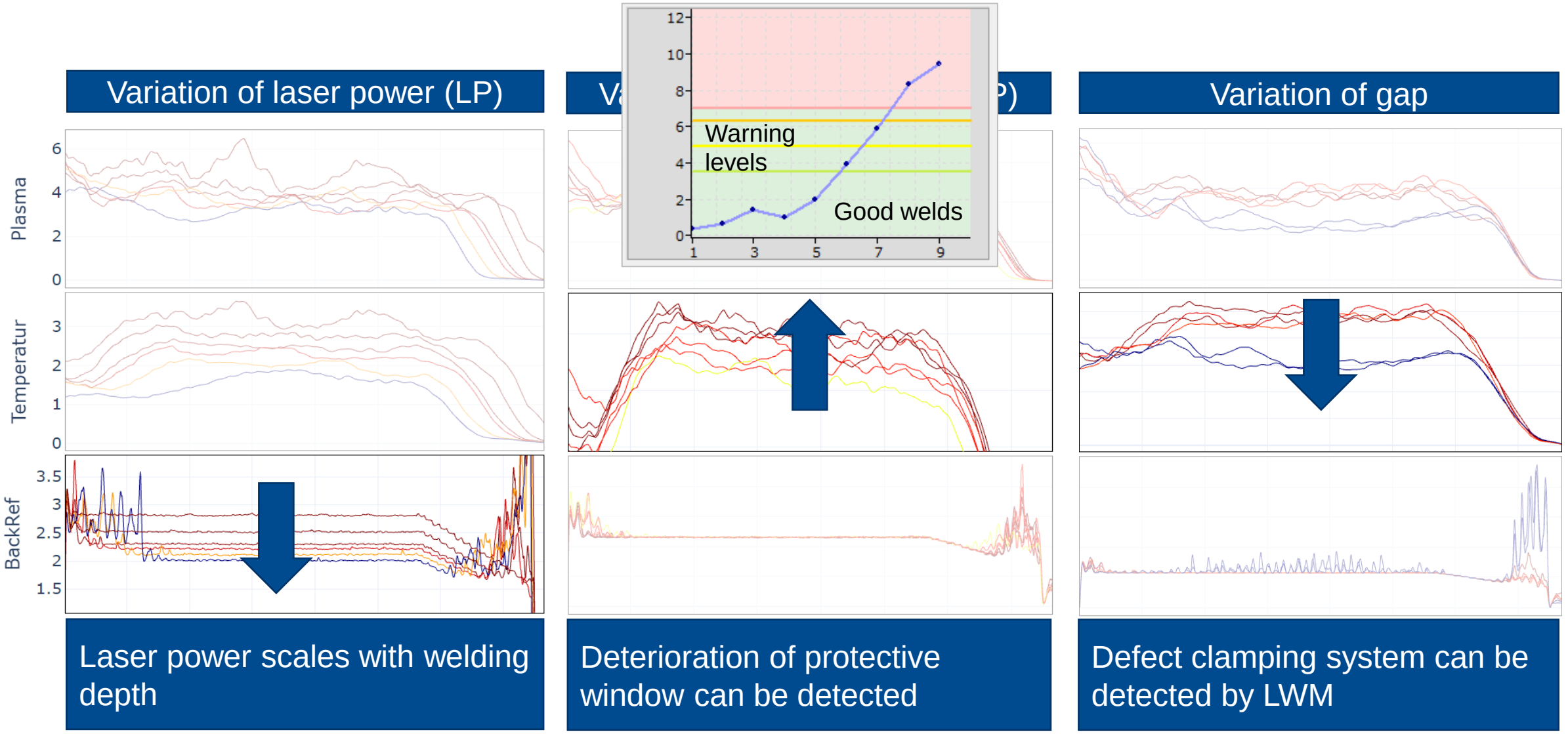

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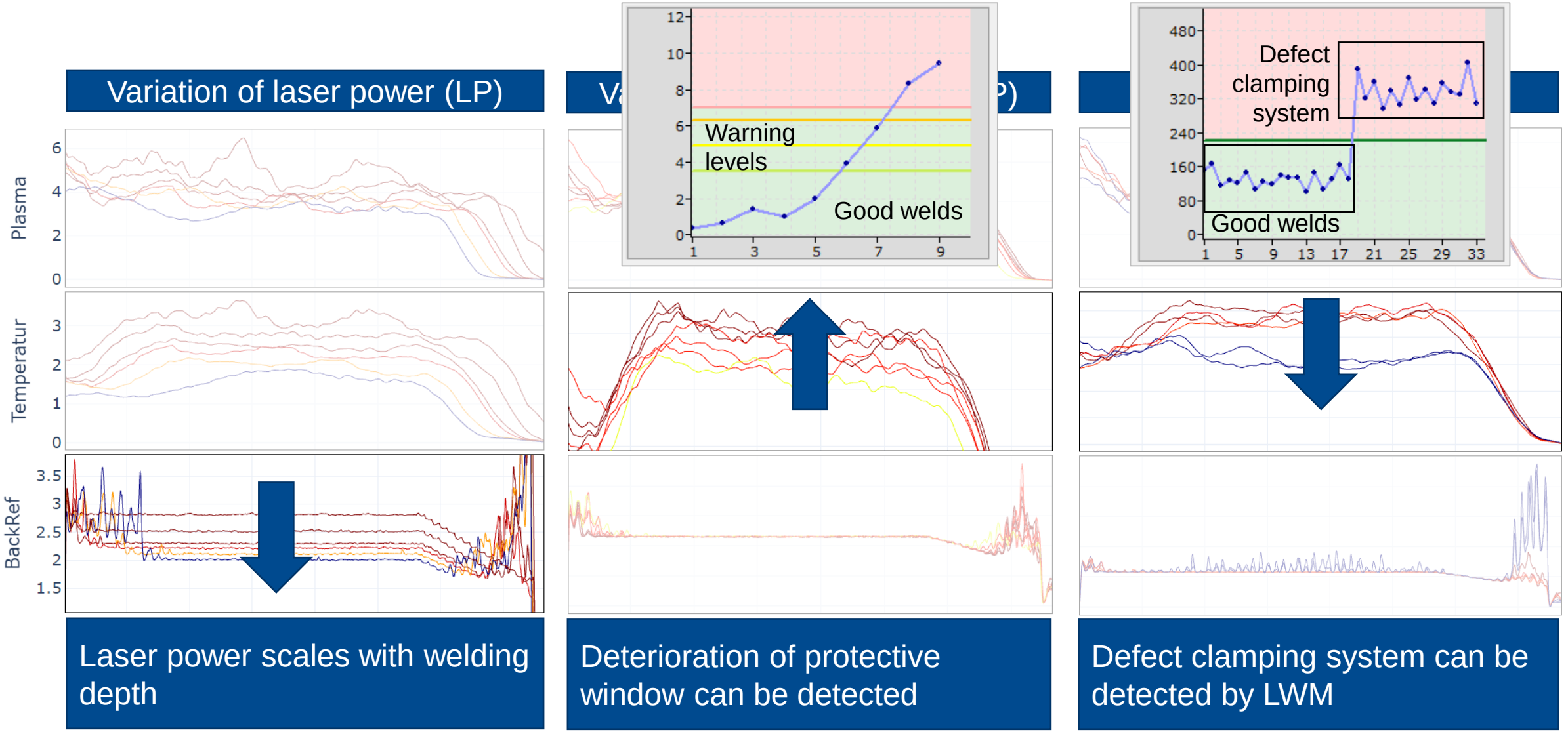
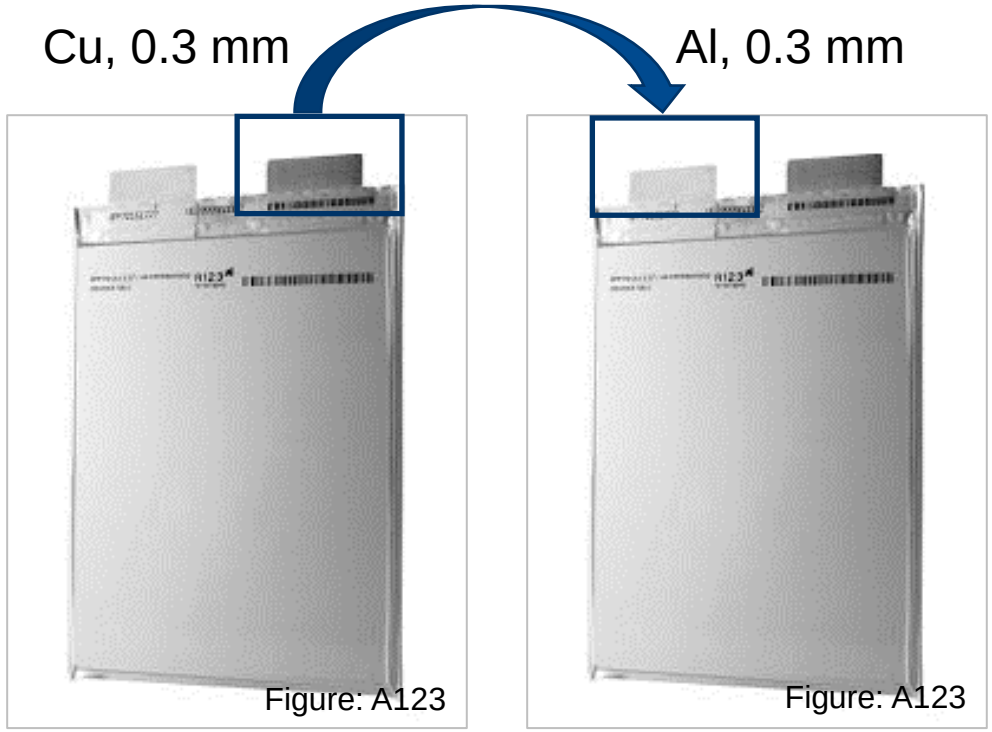


LASER WELDING MONITOR (LWM): FALSE FRIEND

- Main goal: Detection of gaps and the “false friend”
- Approach: LWM (photo diodes)

New sensor: LWM4.0



Patent pending: 10 2020 104 462.3

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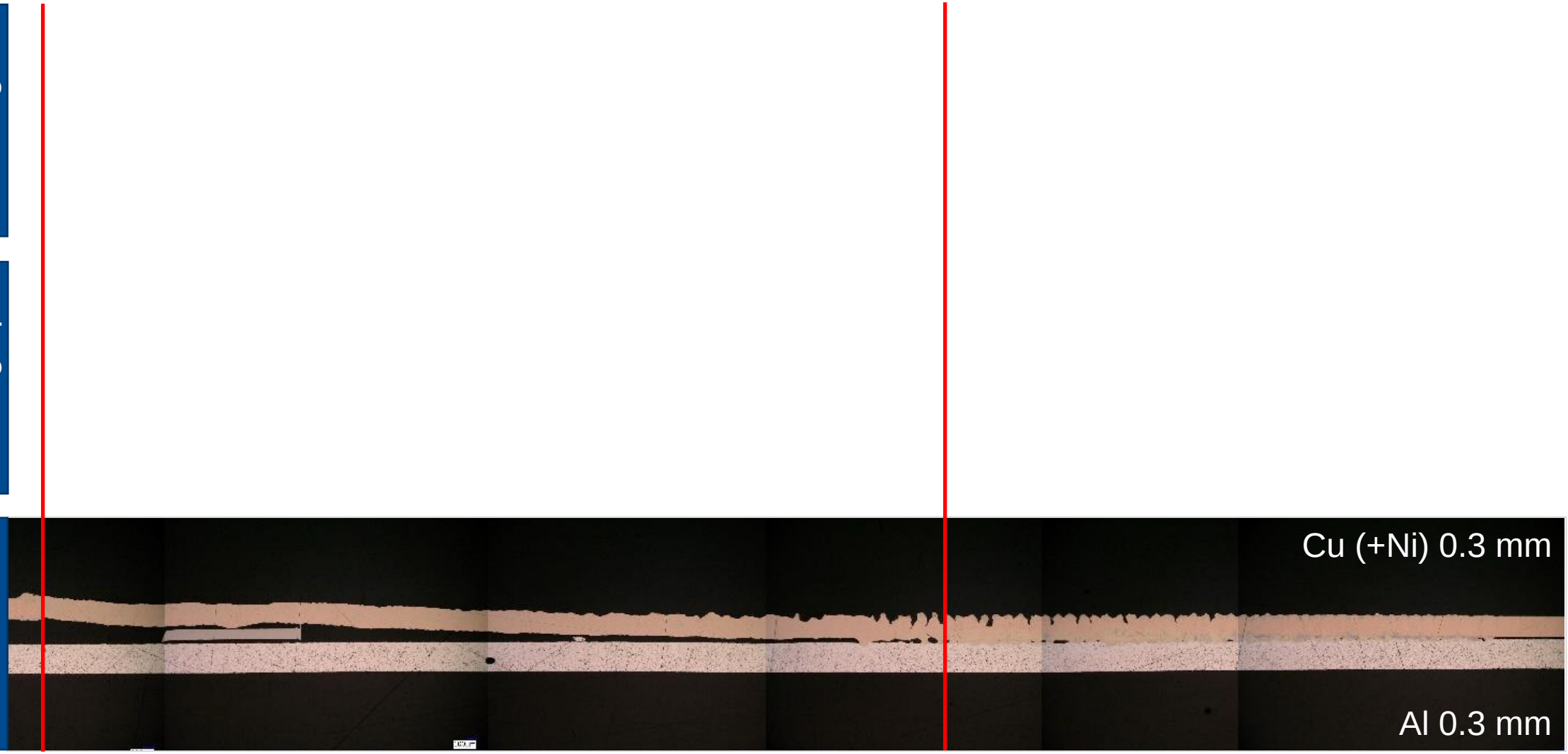
LASER WELDING MONITOR (LWM): FALSE FRIEND

LWM signal

Photograph

Cross section



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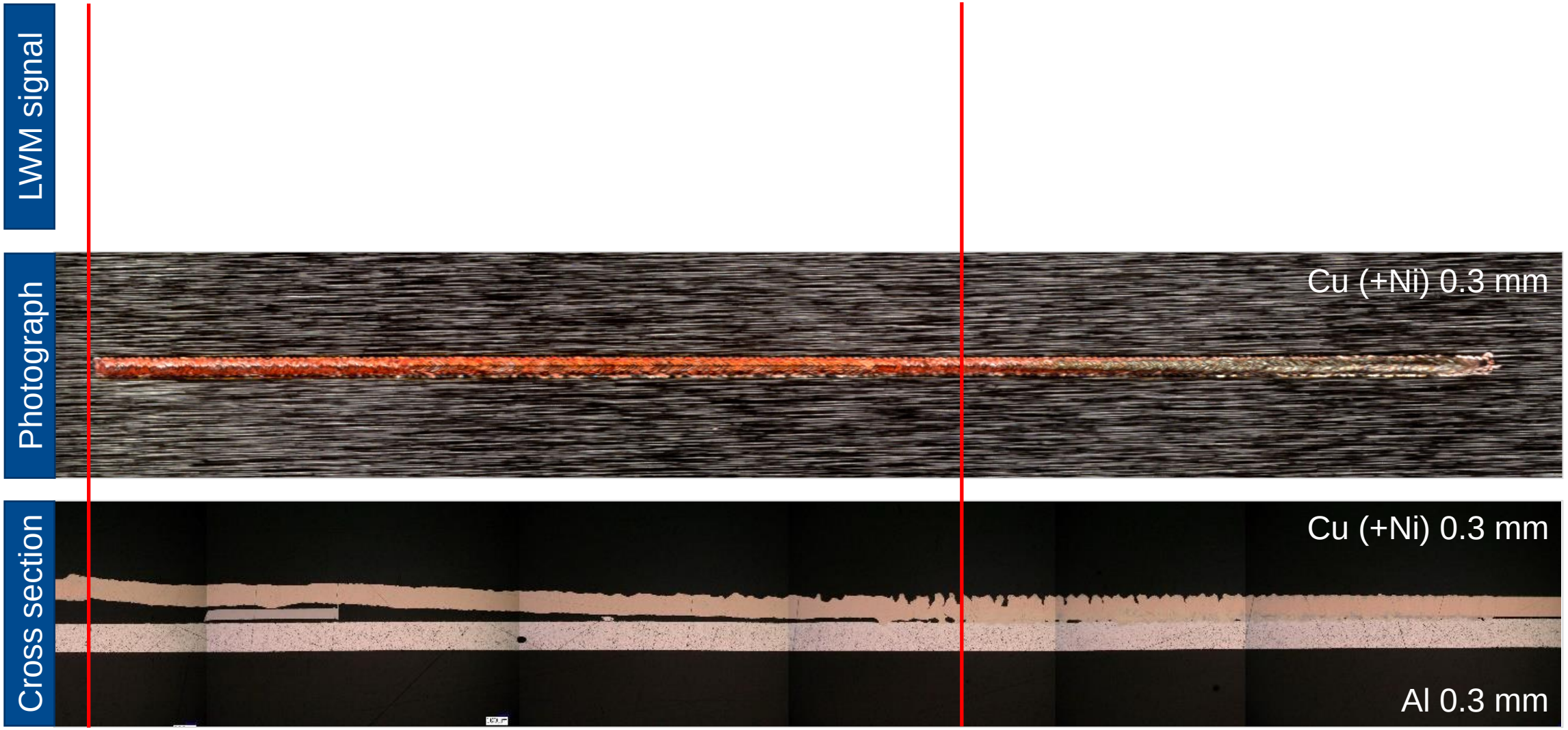

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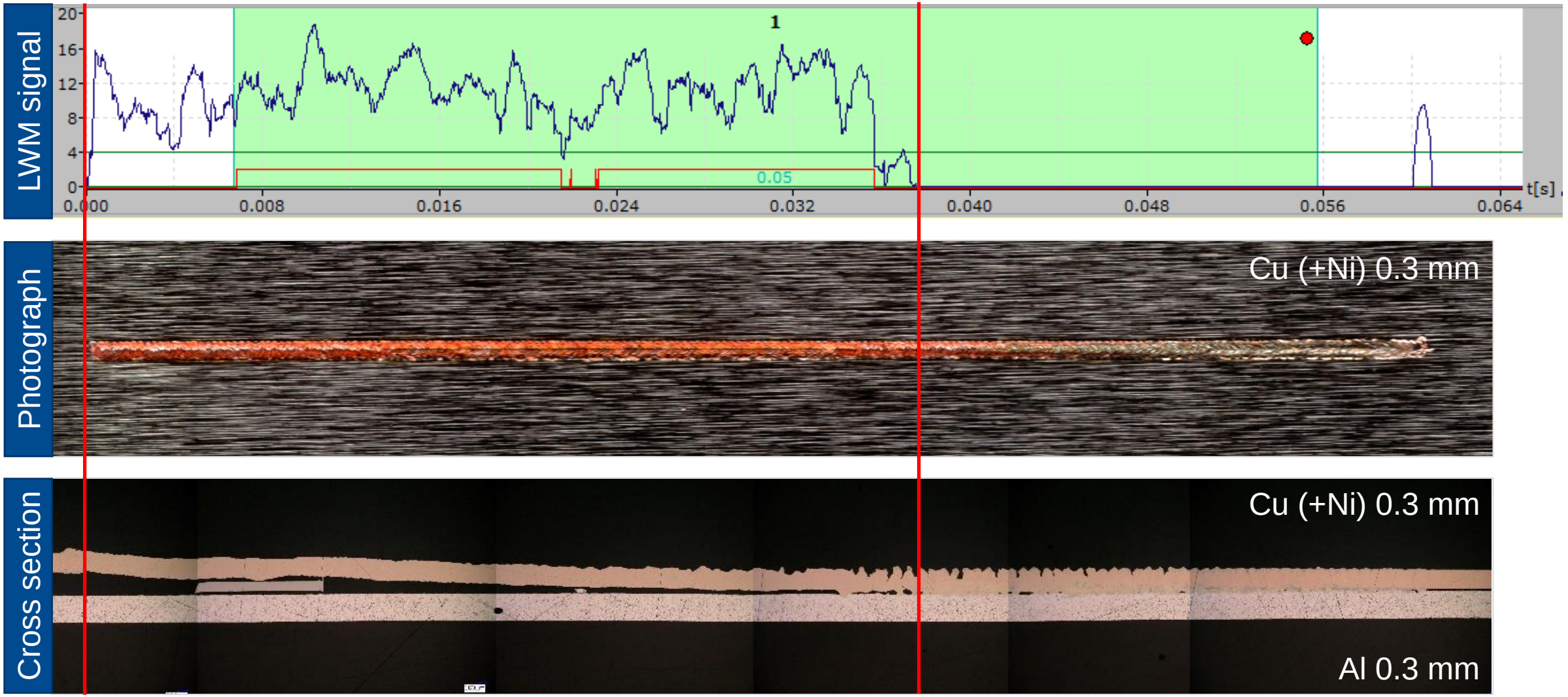

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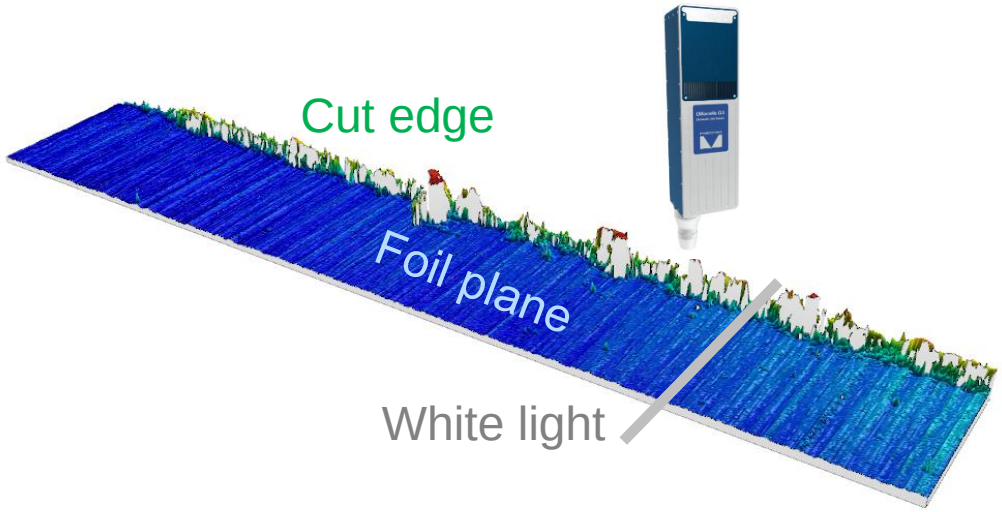
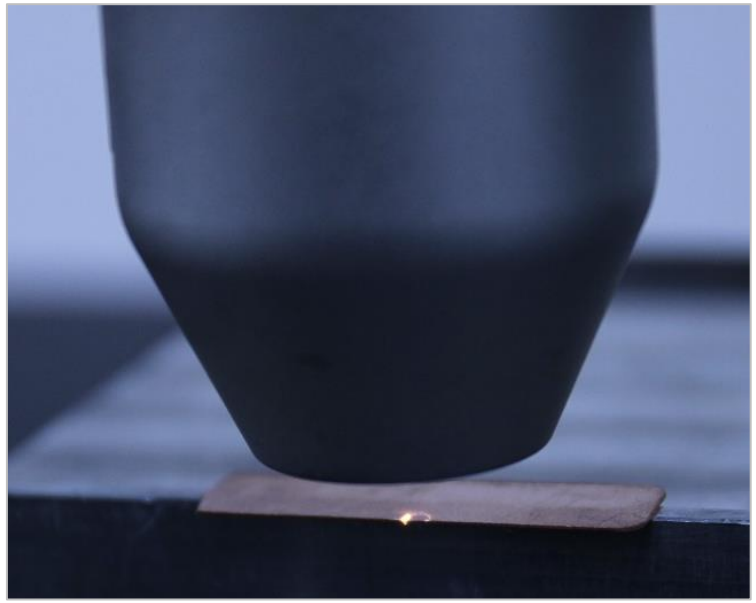
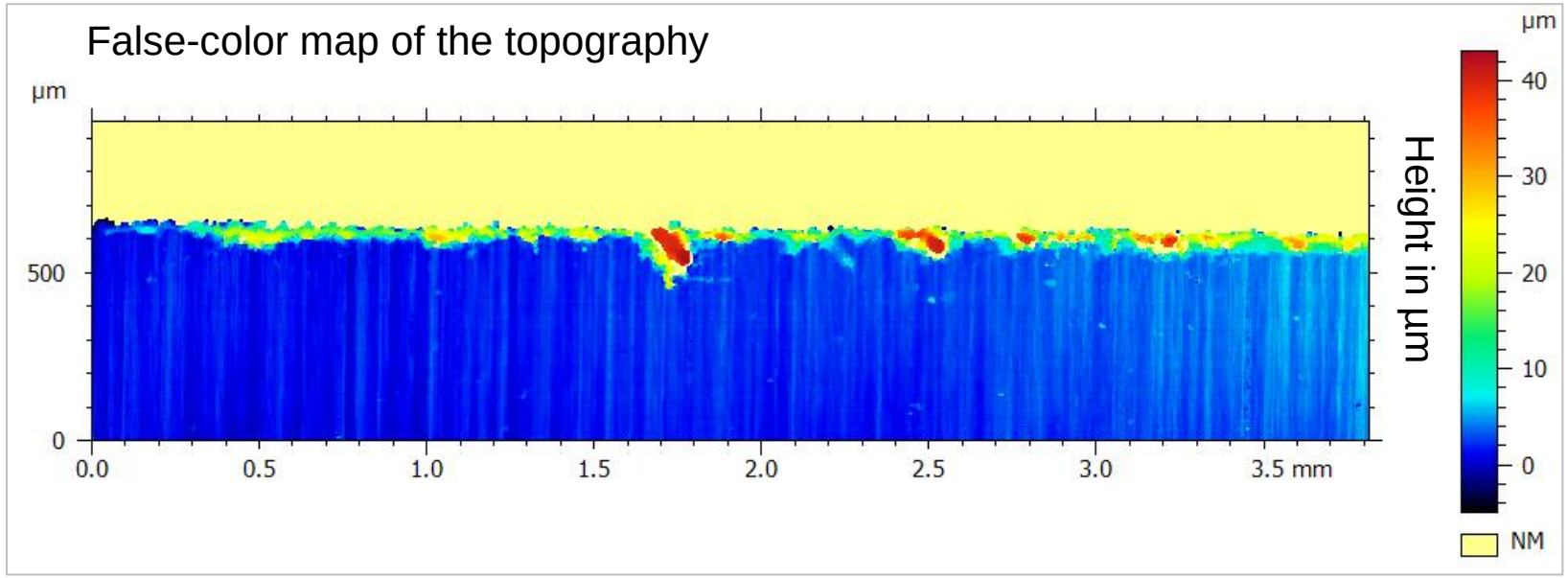
BATTERY CELL PRODUCTION: CUTTING BURR INSPECTION

- Cutting burr inspection (in-line, contactless)
- Main goals: Display of topology, i.e. height over x, y
- Sensor: Chromatic line sensor (CLS), CLS2.0
- Exposure time: 500 us/line, raster 5 um x 5 um







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SUMMARY

- Laser welding monitor (LWM):
  - Photo diode based system
  - Variation of (i) LP, (ii) FP and (iii) gap
  - Detection of “False friend”
- Optical measurement:
  - Cutting burr inspection

LWM4.0


CLS

Industry 4.0: (i) in-line quality control, (ii) transparency, and (iii) traceability

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THANK YOU FOR YOUR ATTENTION

Dr. Ing. Jens Reiser
Sales & Innovation E-Mobility
Tel.: +49 (0) 7225 684 - 359
j.reiser@precitec.de

Precitec GmbH & Co. KG
Draisstraße 1
76571 Gaggenau
Germany

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