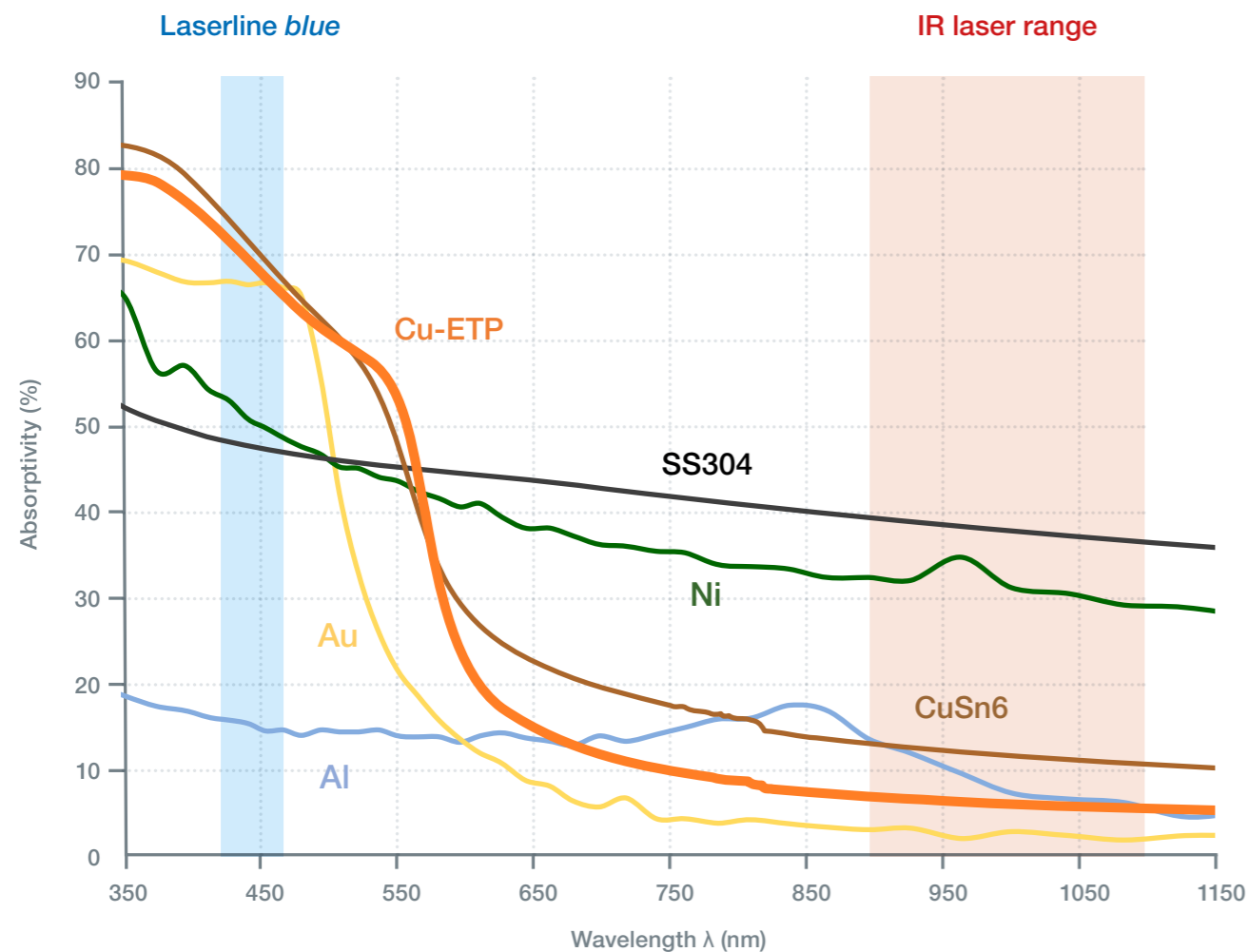
A blue laser beam is directed at a circular array of numerous metal pins or rods. The pins are arranged in concentric circles and are illuminated by the blue light, creating a strong contrast against the dark background. The laser beam originates from the top left and focuses on a single pin in the middle of the array.

*Laserline blue*  
A New Dimension  
in Material Processing

# The Challenge

Low energy absorption of highly reflective metals such as copper or gold in the 1,000 nm wavelength range poses major challenges for standard IR lasers. The required high initial intensities induce processes often characterized by turbulent melt pools and spatter formation, that are critical factors in the processing of electrical components.



Absorptivity of various metals at ambient temperature.  
Sources: Fraunhofer ILT, Hummel et al., Journal of Adv. J. Proc. 1, 2020  
Nasa, E. Spiesz et al., Nasa Technical Note TN-5353, 1969

# The Solution

Laserline's blue high power diode laser series revolutionizes the processing of copper, gold and its alloys in various ways. With approximately 445 nm, these lasers offer the ideal wavelength for the laser processing of highly reflective metals. Multiple times higher absorption allows significantly lower intensities and larger laser spots.



Up to 4,000 W cw available laser power supports both – controlled heat conduction welding and keyhole welding processes.

# Industry Proven System Concept

Blue diode lasers are based on our product families and have been established in industrial applications for many years. They offer the most compact visible lasers in this power class.

The absorption in copper and thus the process efficiency, is increased multiple times compared to IR lasers. This results in smooth, robust and spatter-free welding processes of electrical connectors.

The generation of up to 4,000 W cw blue laser light straight out of laser diodes is unique for industrial lasers. This technology prevents complex and inefficient wavelength conversions.

### Technical advantages at a glance

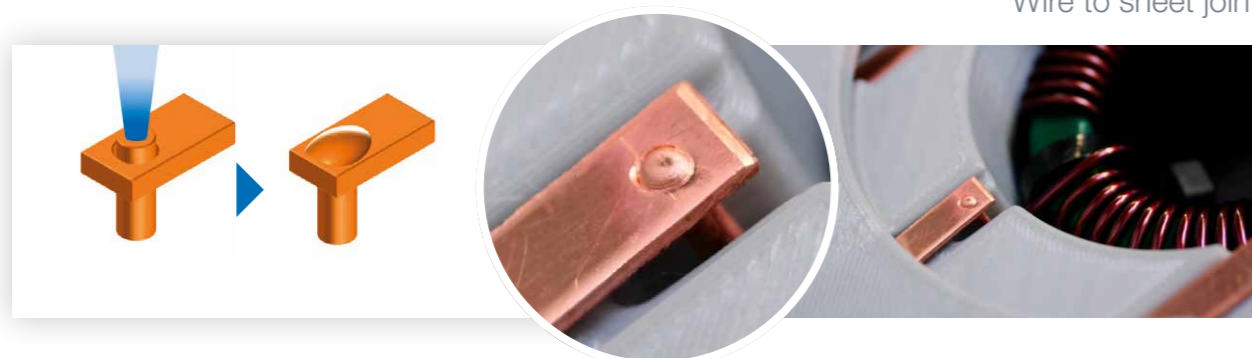
- > Up to 4,000 W cw power at approx. 445 nm
- > Scanner or fixed optic solutions provided for optimal beam delivery
- > Improved absorption on highly reflective metals
- > Industry proven system architecture
- > Highly stable process with calm melt pool characteristics
- > Beam switch option

Various copper connector joint types are easily weldable by blue diode lasers with a single laser pulse:

Wire to pin joint

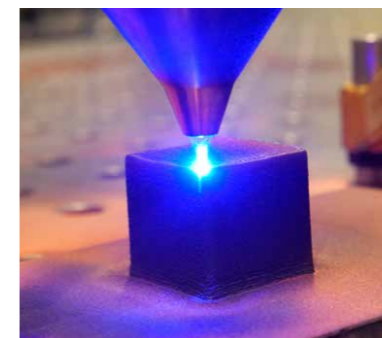
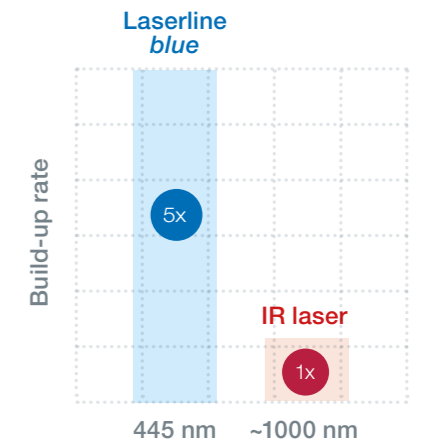


Wire to sheet joint

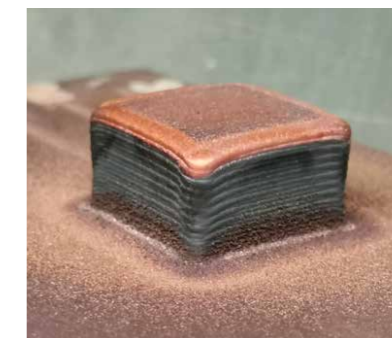


# Additive Manufacturing with Copper and its Alloys

- > At least 5 times higher build-up rates compared to IR lasers
- > Stable process for AM with pure copper and its alloys
- > About 20% more efficient process for Stainless steel, Ni- & Co-alloys



Powder efficiency: > 80%



Build up: pure copper bulk material

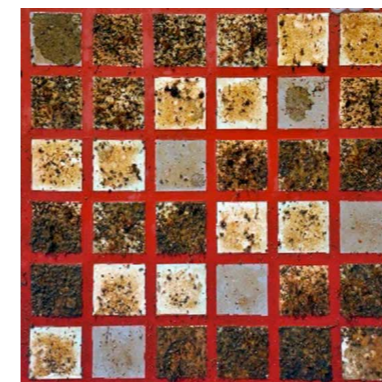


Density: > 99.8%

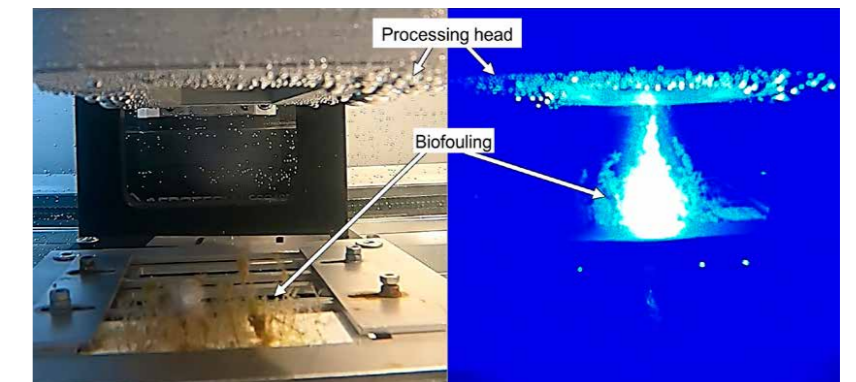
Supported by DMG MORI Ultrasonic LaserTec GmbH

# Underwater Irradiation with Blue Diode Lasers

- > Blue wavelength propagates perfectly in water
- > Underwater irradiation with laser enables a number of heat and bio-chemical processes
- > One example is the removal of stubborn fouling on maritime surfaces (left)
- > Cleaning process is more gentle, environmentally friendly and also more efficient than conventional cleanings
- > The blue laser light of a Laserline LDMblue has a cell-damaging effect
- > The aim is to damage settled marine organisms to an extent that the fouling is washed away by the current

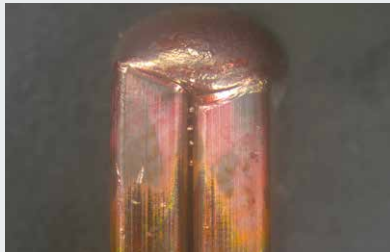
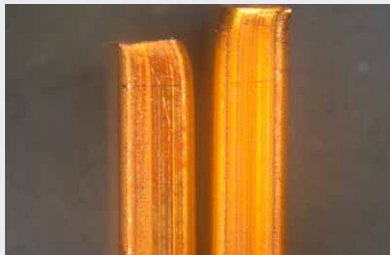
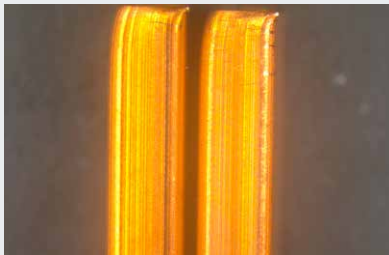


Maritime fouling on samples  
Source: Fraunhofer IFAM



Underwater laser process in side view: Laser off (left) and on (right)  
Source: LZH

## Blue Processing Examples



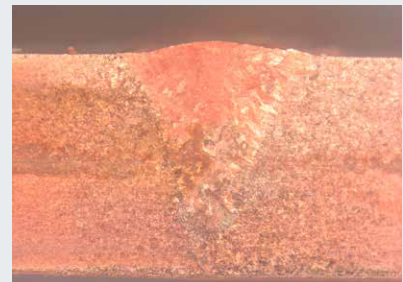
**Hairpin welding:** Easy and robust process due to high absorptivity and large spot size. Overcoming gaps, misalignments and part tolerances.



**Thick copper welding:** Electrical connection with edge joint.



**Dissimilar materials:** Joining of gold coated foil to copper plate.



**Thick copper welding:** Electrical connection in overlap.

## Laserline Blue Diode Lasers at a Glance

Max. output power (cw)*	400 W	800 W	1,800 W	2,000 W	1,500W	3,000 W	4,000 W
Beam quality	20 mm.mrad	20 mm.mrad	30 mm.mrad	60 mm.mrad	20 mm.mrad	30 mm.mrad	30 mm.mrad
Product series	LDMblue				LDFblue		
	Other laser powers and process-adapted beam qualities available						
Wavelength range	445 nm ± 20 nm						

\*Power specification at the output of a 5 m fiber

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