WORKSHOP

Lavorazioni laser nel settore e-mobility: stato dell’arte e prospettive future

Soluzioni LASER avanzate per la saldatura nel settore E-Mobility:

Applicazioni di sorgenti “blu”
Beam-shaping
Remote-welding

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

18-11-2020
INDEX

Who is Optoprim
- Europe/Italy
- Supplier methodology
- Supported processes
- Application center

New opportunities for laser applications:

Blue and Hybrid laser solutions
- Copper problems
- Applications solved

Beam shaping
- Keyhole requirements
- Applications solved

Remote welding
- Position uncertainty
- Applications solved

Conclusions
- Our view
Who is Optoprim

Distributor

• Established in 1994
• 75 employees in Europe
• Goal: Support integrators and end-costumers to better use laser technologies
• Goal: bring new opto-electronics technologies to industrial applications
Who is Optoprim

Italy

- 25 employees
- Italy turnover 2019: 20 M€
- Headquarter in Monza:
  - Commercial offices
  - Warehouse
  - Accounting
  - Backoffice
  - Application center
- Roma:
  - Commercial offices

Corporate foundation
- 1999

Focus on high quality products
- 2009

Micro lab application center establishment
- 2011

High power application center establishment
- 2016

2020
Who is Optoprim

Italy

A new approach to the distribution

- Continuous investment in our application center: people/equipment >10% profit
- High now how in application cases
- Capability to support costumers in developing new processes: IP
- Industrial credibility
- Continuous acquisition of new technologies

![Graph showing turnover from 2010 to 2019 with data points at various € values.]
Who is Optoprim
As supplier

I
Project definition

II
Sales

III
After sales

A
Idea
From the need we can propose new idea based on laser

B
Feasibility study
Realization of new experimental set for feasibility study of industrial processes

C
Design support
We provide input for integration of our components in OEM machines according to our experience and the feasibility study

D
Pilot run and testing
Realization of pre series production with the defined set up

E
Final design
Final definition of the technical spec related to the process and the equipment
Who is Optoprim
Process supported

- Brazing
- Cladding
- Marking
- Welding
- Cutting
- Heat treatment
Who is Optoprim

Our structure

1. Clean rooms
2. Training room
3. Metallurgical section
4. Warehouse
5. Scanning application area
6. Gantry and robotic system application areas
Who is Optoprim

Our partners
INDEX

Who is optoprim
- Europe/Italy
- Supplier methodology
- Supported processes
- Application center

New opportunities for laser applications:

Blue and Hybrid laser solutions
- Copper problems
- Applications solved

Beam shaping
- Keyhole requirements
- Applications solved

Remote welding
- Position uncertainty
- Applications solved

Conclusions
- Our view
New opportunity for laser applications

New available Laser processes in e-car

- Battery welding
- Stator welding
- Transmission Welding
- Plastic Marking/Welding

Tab Welding, Case battery welding
Hairpin welding, Hairpin cleaning
From the rotor to the crack-shaft
All plastic cases marking, plastic cases welding
INDEX

Who is optoprim
- Europe/Italy
- Supplier methodology
- Supported processes
- Application center

New opportunities for laser applications:

Blue and Hybrid laser solutions
- Copper problems
- Applications solved

Beam shaping
- Keyhole requirements
- Applications solved

Remote welding
- Position uncertainty
- Applications solved

Conclusions
- Our view
COPPER vs LASER
Absorption and heat conductivity

CRITICAL ISSUE ON COPPER

• Low absorption of infrared light (Yb:YAG) 5%
• Absorption increases after melting at IR
• Heat conductivity is higher at solid state

Different wavelength might help increasing the absorption at material solid state

Blue diode maximize the absorption of copper in solid state condition

Blu laser could be used to easily bring the copper at melting point and later the IR could be used to penetrate more
Hybrid laser application

Absorption and heat conductivity

**CRITICAL ISSUE ON COPPER**

- Low absorption of infrared light (Yb:YAG) 5%
- Absorption increases after melting at IR
- Heat conductivity is higher at solid state

01

Different wavelength might help increasing the absorption at material solid state

02

Blue diode maximize the absorption of copper in solid state condition

03

Blu laser could be used to easily bring the copper at melting point and later the IR could be used to penetrate more

*All the pictures are laserline propriety*
Hybrid laser application
Absorption and heat conductivity

*All the pictures are laserline propriety*
Hybrid laser application

Penetration capability

Description
1000 W Blue
3000 W IR
Penetration 1,45 mm

Description
1000 W Blue
3500 W IR
Penetration 1,91 mm

Description
1000 W Blue
4000 W IR
Penetration 2,36 mm

*All the pictures are laserline propriety*
Blue laser application

Hairpin

*All the pictures and videos are laserline propriety
INDEX

Who is optoprim
- Europe/Italy
- Supplier methodology
- Supported processes
- Application center

New opportunities for laser applications:
Blue and Hybrid laser solutions
- Copper problems
- Applications solved

Beam shaping
- Keyhole requirements
- Applications solved

Remote welding
- Position uncertainty
- Applications solved

Conclusions
- Our view
Fiber laser applications

Beam Shaping

01
There is no one beam shaping solution for every alloy and application, but commonly a higher intensity core plus a shoulder of power helps to widen the keyhole and improve stability.

02
Outer ring could be used for enlarge the key-hole or pre-heat or post-heat the welding.

03
Fast process to limitate metallurgical mixture of incompatible materials.

*All the videos are nLight propriety*
Fiber laser applications

Beam Shaping

*All the videos are nLight propriety
Application cases

Summary
Application cases

Aesthetics examples

CFX-4000 @2.6 kW
Up to ~ 4kW
2.6 kW 200 mm/s
3.8 kW 300 mm/s
Met speed and quality specs

*All the pictures are nLight propriety
INDEX

Who is optoprim
- Europe/Italy
- Supplier methodology
- Supported processes
- Application center

New opportunities for laser applications:
Blue and Hybrid laser solutions
- Copper problems
- Applications solved

Beam shaping
- Keyhole requirements
- Applications solved

Remote welding
- Position uncertainty
- Applications solved

Conclusions
- Our view
CRITICAL ISSUE IN POSITIONING

- Laser spot dimensions: order of 200 um
- Large working area scanner
- Uncertainty in positioning the part in the same point

01 Pattern repositioning is needed

02 Simple scanning system to be integrated

*All the pictures are K-Lab propriety*
CRITICAL ISSUE IN POSITIONING

- Laser spot dimensions: order of 200 um
- Large working area scanner
- Uncertainty in positioning the part in the same point

01 Pattern repositioning is needed

02 Simple scanning system to be integrated and to be taught

*All the videos are K-Lab propriety
Application cases

Fast process to mitigate metallurgical material mixture

**MATERIALS**

- Rame 0.2 mm
- Acciaio 0.6 mm

---

**MATERIALS**

- Rame 0.30 mm
- Alluminio 0.45 mm

---

*Saldatura Celle cilindriche*

*All the pictures are uniBO propriety*
Application cases

Hairpin – Butteries

MATERIALS

AI1050-AI1050

Welding speed

80 mm/s

60 mm/s

*All the pictures are uniBO propriety

*All the pictures are nLight propriety
Who is optoprim
- Europe/Italy
- Supplier methodology
- Supported processes
- Application center

New opportunities for laser applications:

Blue and Hybrid laser solutions
- Copper problems
- Applications solved

Beam shaping
- Keyhole requirements
- Applications solved

Remote welding
- Position uncertainty
- Applications solved

Conclusions
- Our view
### Conclusions

#### Application overview

<table>
<thead>
<tr>
<th>APPLICATIONS</th>
<th>BLUE</th>
<th>HYBRID</th>
<th>IR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Batteries cells, Thin hairpins, PCB Copper foils</td>
<td>High power electronics Thin and thick hairpins</td>
<td>High power electronics Thin &amp; thick hairpins</td>
<td></td>
</tr>
</tbody>
</table>

![Images](image1.png) ![Images](image2.png) ![Images](image3.png)

---

![Images](image4.png) ![Images](image5.png) ![Images](image6.png)
Hairpin Manufacturing processes

Welding: set up options

Laser source
- Fiber laser
- Blue/IR Diode Laser

Beam delivery
- Remote welding
- Proximity welding

Process monitoring
- Weld watcher
- Process observer
Contacts

Our locations

Monza office
Telephone: +39 039834977
Address:
Via Rota 37
20900, Monza (MB)

Roma office
Telephone: +39 06 87657838
Address:
Via Monte Giberto, 15
00138, Roma