Current Trends in Car Body Laser Applications

06th of July, 2018
Konstantin Ribalko, M.Sc.
Laserline Overview

Laserline – Company

- Head office, Mülheim-Kärlich, Germany
- Founded in 1997
- Privately owned company: Dr. Christoph Ullmann and Volker Krause
- Over 300 employees
- Active world wide
  - Subsidiaries in China, USA, Japan, Korea, Brazil
- Continuous growth over the last years
- Leading company in high power diode lasers for industrial use
  - Laser Products
  - Applications center
  - After-sales service
- More than 4500 systems installed
Automotive Applications - Overview
Diode Lasers for Automotive Applications

LASER
Typical power range in BIW
4,000 - 6,000 W

- 4,000 W @ 4 mm mrad
- 6,000 W @ 6.8 mm mrad
- 7,000 W @ 30 mm mrad
- 9,000 W @ 40 mm mrad
- 15,000 W @ 60 mm mrad
- 20,000 W @ 100 mm mrad

Brazing Steel
Welding Steel
Remote
Remote
Welding Al.
Cutting
Brazing Steel
Diode Lasers for Automotive Applications

Current application example, recent generation Audi A3:
- Installation in 2012
- Laser brazing of roofs and tailgates

1st application Audi A3:
- Installation in 2001
- Laser brazing of tailgates
- 24/7 Production
Brazing Steel

Diode Lasers for Automotive Applications

- Tight seams with smooth surface
- No or minimal rework
- Painting directly after joining
- No plastic cover necessary

Source: Audi
Brazing Steel

Triple-Spot-Modules for brazing

Hot dip galvanized material for the body in white

Advantages of HDG material

- Substitution of electro-galvanized material
- Corrosion resistance
- No phosphat treatment before forming
- Worldwide availability
- Cost of material

Laser brazing of galvanized material

Seam surface on HDG-material

Seam surface on EG-material

“Wavelet” Spatter

Source: W. Reimann, VW, EALA 2015
Triple-Spot-Modules for brazing and welding

Idea

Integrated in Scansonic ALO3 (M1,7)

Designed for HDG sheets and -60 diode lasers

- Circular front spots
- Main spot for brazing process
Triple-Spot-Modules for brazing and welding

Idea – improving critical processes

“OR”-Module integrated in Scansonic ALO3 (M1,7)

Circular front spots

Main spot for brazing process

Seam surface on HDG-material
Seam surface on EG-material

Source: W. Reimann, VW, EALA 2015

4,5 m/min
4,7 kW
Brazing Steel
Status of Triple-Spot-Modules

- Process qualified since 2016
- Installed in many VW production lines in 2016, 2017 and 2018
- HDG applications in tailgates and roofs all around the world:
  Germany, Slovakia, Czech Republic, Mexico, South Africa, China, Portugal and more coming up
Aluminum Welding

Diode Lasers for Aluminum Welding

Process:
- Localized heat input: laser beam melts the wire and base material
- Process speed 2 to 5 m/min
- Spot size: 0,6 mm
- Typical laser: LDF 5000-30
- Typical optics: Scansonic ALO3 with al. options

Advantages:
- Stability of diode laser in process with large back reflection
Aluminum Welding

Common Seams in Aluminum Welding

- Filler wire: AlSi- or AlMg based
- Applications:
  - zero-gap roof joint: e.g. Audi TT, A8
  - divided tailgate: e.g. Audi Q5, Q7
  - Doors: e.g. Audi A6, A7, A8

Audi: Marco Heitmanek, Dr. Matthias Graudenz. Dresden 2012
Aluminum Welding

Aluminum welding of outer skin parts – tail gates

Source: Audi, C.Ebert 2009 © Laserline GmbH
Aluminum Welding

Aluminum welding of outer skin parts - roof joint

Source: Audi, C.Ebert 2009 © Laserline GmbH
**Aluminum Welding**

**Aluminum welding of structure parts – door Audi A6**

- No use of resistance spot welding
- Compared to steel limited deep drawing properties

=>$>$ Inner structure made of two parts and welded by laser stitch welds

- Shorter flanges in the door halo welded by stitch welds

---

*fillet weld*

*overlap joint*
Aluminum welding – with Multi-Spot-Module

Spot in spot welding with Multi-Spot-Modules

Integrated in Scansonic ALO3 (M1,7/ 1,1/ 0,9)
Designed for welding With -30 or -40 diode lasers

- Circular center spot
- Square outer spot
Aluminum welding - with Multi-Spot-Module

Typical results – coach joint

- Al 6000 with AlSi 12 wire
  - Uneven seam with notches
  - Welding speed 3 m/min
  - Risk of micro cracks

- Smooth seam
  - 4.5 m/min @ 3.6 kW
  - 1.2 mm AlMg4.5MnZr wire
Aluminum welding - with Multi-Spot-Module

Typical results – coach joint

- **Single spot**
  - Al 6000 with AlSi 12 wire
    - Uneven seam with notches
    - Welding speed 3 m/min
    - Risk of micro cracks

- **Version 4**
  - Smooth seam
  - V rob 8 m/min @ 4,1 kW,
    V wire 10 m/min
  - 1.2 mm AlMg4.5MnZr wire
New Spot-in-Spot module for welding

First experiences in production

- reduced heat input and distortion compared to single spot
- larger process window
- less pores and joint defects
- less spatters
- less rework
Remote Welding in Aluminum

Laser Beam Remote Welding in Aluminum

- Guided laser beam is oscillating perpendicular to the seam
- Laser power is modulated according to position of the beam
- Prevention of hot crack susceptibility due to selective partial penetration welding
Remote Welding in Aluminum

Remote Welding in Production

- Implementation in Audi A8 production
- Remote welding substitutes tactile welding process
- Saving of running costs by > 90 %
- Saving of cycle time by > 50 %
- invisible weld from back side

Foto: Audi

Welding side

Back side Welding
Remote Welding in Steel

Standard applications in doors

- Tailored Blanks
- Structure welds
  - Remote welding in steel

Source: TKSY, Highyag

Laserline GmbH
Metal Welding

AMTB - Tailored Blanks Welding
Metal Welding

Tailored Blanks: Hot Stamped Door Ring

- 1 part instead of 4
  - One stamping tool
  - One stamping operation
  - No post assembly operations

- Lightweight concept: 20 % savings
  - Hot stamping steel grades
  - Optimized thickness distribution
  - Laser weld continuous links (no overlap)

- Hot-stamping geometry accuracy
Metal Welding

Tailored Blanks: Parts
Almost all major OEM’s introduced lasers for standard BIW applications

References
Summary

- Leading in multi kW high power diode lasers and accessories
- Over 4,500 lasers installed, 1000 in BIW
- Over 300 employees
- Market leader in Automotive Brazing
- The right lasers for every application: Brazing, tactile welding, remote welding and many more.
- Continuous development of technology to improve the application

Thank you for listening!