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ANALYSIS OF THE PROPERTIES OF AW6082 ALUMINIUM ALLOY WELD JOINTS PRODUCED WITH DISK LASER

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1. Introduction

Aluminium and its alloys have been extensively used for their unique properties such as high specific strength and corrosion resistance. Application of laser beam welding (LBW) for joining aluminium alloys offers great potential due to the advantages of this welding method. The LBW is characteristic mainly by low heat input, low deformations and high welding speeds. Fusion welding of heat treatable aluminium alloys is associated with the decrease in mechanical properties. Another weld defects which could be encountered in fusion welding of aluminium alloys are porosity and hot cracking. Hot cracking is one of the major challenges in welding of the 2XXX, 6XXX and 7XXX series of aluminium alloys. Furthermore, aluminium alloys possess high reflectivity of laser radiation by their surface [1-5].

This study is focused on the analysis of the effect of welding parameters on the properties of AW6082 heat treatable aluminium alloy weld joints, which were produced with TruDisk 4002 disk laser.

2. Experimental

AW6082 heat treatable aluminium alloy with the thickness of 1 mm was proposed as the base material.

Butt weld joints were produced by TruDisk 4002 disk laser. The maximum laser power is 2 kW. BEO D70 focusing optics was used for welding. Focal length was 200 mm. Laser light cable with the core diameter of 400 μm was used for transporting laser radiation from the source to the focusing optics. Laser beam was focused on the surface of materials to be welded. The spot size was 400 μm. Welding without the use of filler metal was carried out. Argon with the flow rate of 18 l/min was used as shielding gas in order to protect the weld pool against ambient atmosphere.

Light microscopy, electron microscopy including EDS analysis, microhardness measurements and tensile testing were used for assessment of the properties of produced weld joints.

3. Results

The cross section of selected weld joint is given in Fig. 1. The weld bead is smooth, no porosity and hot cracking was observed in this case.

Fig. 1. Cross section of selected weld joint

Weld metal – AW6082 aluminium alloy interface is documented in Fig. 2. Columnar dendrite structure was observed at the fusion boundary. Heat affected zone was very narrow, due to the low heat input characteristic for LBW and high thermal conductivity of aluminium alloys.

The higher the laser power the larger the weld metal. Only partial penetration of base metals was observed at the welding speed of 90 mm/s. It was necessary to reduce the welding speed and thus increase the heat input.

Fig. 2. Weld metal – AW6082 interface

The microstructure of weld metal is given in Fig. 3. The matrix is formed by α-Al solid solution. Based on EDS analysis results, it could be stated that aluminium content up to 96.9 wt. % was detected in this location. Contrary, higher amounts of alloying elements such as Si, Mn and Fe were detected in interdendritic areas due to segregation.

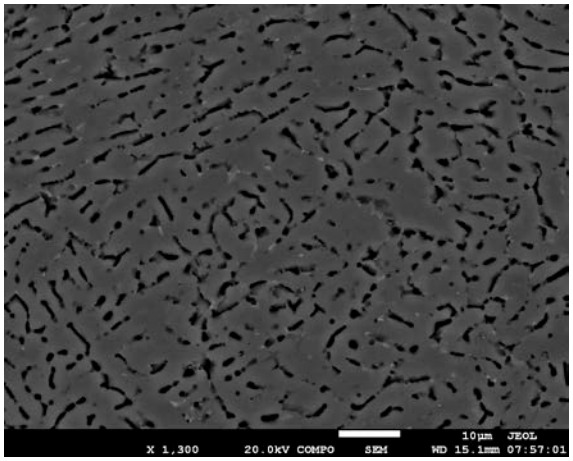

Fig. 3. Microstructure of weld metal

4. Conclusion

- butt weld joints on AW6082 heat treatable aluminium alloy without the presence of hot cracking and porosity were successfully produced by disk laser,
- weld metal was formed by aluminium matrix (α-Al solid solution), interdendritic areas were enriched by alloying elements due to segregation,
- decrease in microhardness from base material towards weld metal was observed due to the dissolution of strengthening precipitates in weld metal during welding,
- tensile strength of weld joints was lower in comparison to the strength of base metal, i.e. the fracture occurred in weld metal.

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