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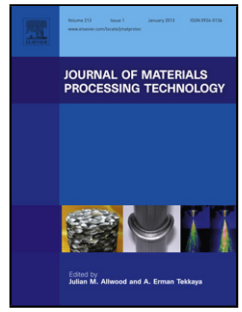

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Yb: YAG laser welding of dual phase steel to aluminium alloy

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Abstract:

In this work, laser welding of dual phase steel (DP 600) to aluminium alloy (AA 6061) was studied both experimentally and by computational modeling. Three different laser energy densities (640 J/mm^2, 850 J/mm^2 and 1250 J/mm^2) were chosen to study the effect of heat input on microstructural changes and strength of the joint. It was inferred from the results that the laser energy density had a direct influence on the formation of intermetallic phases such as Fe_2Al_5 and $FeAl_3$. At relatively high laser energy density (1250 J/mm^2), thick intermetallic layer and crack propagations were observed at the interface of the weld, which deteriorated the strength of joint. Whereas, maintaining the laser energy density at 850 J/mm^2 enhanced the weld quality by lowering the intermetallic thickness in the range of 6 – 10 µm and defects such as cracks were also lowest at the weld interface. The formation of the cracks in the interfacial region was largely influenced by the hard and brittle intermetallics, which was evident from the microhardness results. The microhardness value along the interface exhibited a maximum of 836 HV at 1250 J/mm^2, which was much higher than the base metal hardness (AA 6061 – 65 HV, DP 600 - 255 HV). A two-dimensional computational model was used to predict the temperature histories at different laser energy densities during welding. The results of the computational model (penetration depth and material ablation) correlated well with the experimental results.

Keywords: Advanced high strength steel, dual phase steel, aluminium, laser energy density, intermetallic compounds, heat-affected zone.