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Comparison of mechanical and microstructural properties by heat source of laser-arc hybrid welding using Aluminum alloys

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High-strength aluminum alloy is attracting attention as a key material for strengthening carbon emission regulations and reducing the weight of vehicle parts to improve fuel efficiency, and the development of welding method to apply it is necessary. However, the high thermal conductivity of aluminum alloy and the presence of an oxide film require high energy density heat input, and it is difficult to secure neat welds and mechanical properties due to limited penetration depth.
To address this issue, we attempted to realize high-efficiency and high-quality welding by developing laser-arc hybrid welding. However, optimization to secure neat welds according to the output parameters of the ARM (Adjustable Ring Mode) laser and arc heat source is insufficient.

Therefore, this study aimed to investigate the effects of heat input parameters (laser mode, arc current) on weld bead and weld zone quality in laser-arc hybrid welding of aluminum AA6N01-T5, a material commonly used in vehicle parts. We observed the formation of weld bead and weld zone according to the melting and solidification phenomena induced by the mode of ARM lasers and arc sources. Furthermore, analysis was conducted on the mechanical properties and microstructures of the arc-dominated zone and laser-dominated zone.