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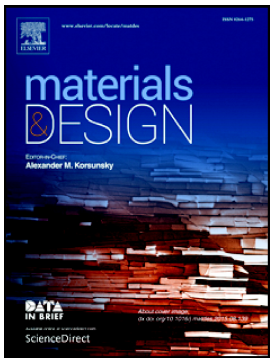

Decreasing the surface roughness of aluminum alloy welds fabricated by a dual beam laser

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Highlights

1. Practical methods were provided to mitigate humping and rippling on the weld surface.
2. The jet flow was experimentally visualized.
3. The effects of nozzle shape, gas flow rate, and inclination angle of the gas tube on the surface roughness of aluminum welds were discussed.

Abstract:

Decreasing the surface roughness of visible laser welds on aluminum automotive closure panels is of critical importance in the automotive industry. During welding, surface roughness is strongly influenced by the interaction of filler wire, laser, and gas. Observation by CCD camera revealed that placement of the filler wire tip at the front wire-feeding position could effectively mitigate humping phenomenon on the weld surface. Visualization of the gas flow and detection of the plasma intensity demonstrated that optimizing the shielding gas parameters could further reduce the rippling phenomenon by affecting the molten pool surface tension and the pressure differential acting upon the molten pool. The surface quality could be improved via optimization of nozzle outlet geometry, gas flow rate, inclination angle of gas tube, and distance between the nozzle and laser beam. After shrinking the processing parameter window through the single factor investigation, a Taguchi L9 orthogonal array was designed to optimize the shielding gas parameters. The weld surface roughness, Ra, could be effectively reduced to below 1 μm when a circular gas nozzle was positioned at 5 mm behind the laser beam, delivering pure argon gas at 30 SCFH with an inclination angle of 45° to the horizontal plane.

Keywords:

Dual beam laser, surface roughness, aluminum alloy

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