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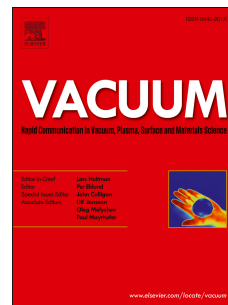
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Abstract:

Fiber laser welding of aluminum alloy under vacuum was performed in this study. To understand the increases in weld penetration depth and changes in weld cross section profile in laser welding under vacuum or subatmospheric pressure, the effect of ambient pressure on interaction between laser radiation and plasma plume was studied. The electron temperature, electron density and inverse bremsstrahlung absorption of laser energy were calculated by spectroscopic analyses. The attenuation and refraction of laser energy from plasma plume were studied by probe laser beam measurements. It was found that the inverse bremsstrahlung absorption, attenuation and refraction of laser energy were sensitive to ambient pressure and decreased with the decrease of ambient pressure. Based on the effect of ambient pressure on boiling temperature of materials and interaction between laser radiation and plasma plume, the laser energy absorption mechanisms between atmosphere and vacuum was compared. The finding suggested that the decreasing of plasma plume disturbance, the increasing of the laser energy in keyhole and the decreasing of boiling temperature changed the absorption mechanism of laser energy, resulting in a large aspect ratio with narrow and parallel sides of weld cross section profile under vacuum.

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