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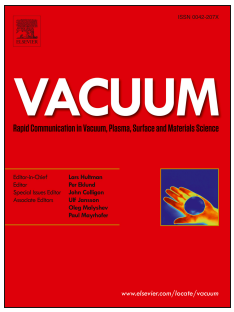

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PII: S0042-207X(17)31285-X

DOI: 10.1016/j.vacuum.2018.02.008

Reference: VAC 7809

To appear in: *Vacuum*

Received Date: 20 September 2017

Revised Date: 3 February 2018

Accepted Date: 5 February 2018

Please cite this article as: Li L, Peng G, Wang J, Gong J, Li H, Experimental study on weld formation of Inconel 718 with fiber laser welding under reduced ambient pressure, *Vacuum* (2018), doi: 10.1016/j.vacuum.2018.02.008.

Experimental Study on Weld Formation of Inconel 718 with Fiber Laser Welding under Reduced Ambient Pressure

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Abstract: A 10 kW fiber laser was used to join 10-mm-thick Inconel 718 alloy plates. Humping, porosities and splash occurred during laser welding under atmosphere pressure. Laser welding under reduced ambient pressure could be beneficial for improving the weld formation and penetration depth. The experimental results showed that weld appearance became smooth and bright with the decrease of ambient pressure. A penetrated welding joint without defects was obtained when the ambient pressure was 4×10^{-3} Pa. Distribution of plasma showed that the plasma area decreased due to the less mutual collision frequency between particles under lower ambient pressure. Smaller area of plasma resulted in a higher laser energy absorption efficiency, which finally led to a deeper penetration. The computational results indicated that the boiling points of these alloying elements decreased sharply when the ambient pressure reduced. Lower boiling points of these alloying elements helps to form a more stable molten pool, which finally led to the satisfactory weld formation.

Keywords: Laser welding, Inconel 718 alloy, Reduced ambient pressure, Penetration, Mutual collision.

1 Introduction

Inconel 718 alloy is more and more widely used in the area of aviation and petroleum pipeline for its great performance of creep resistance and thermal stability at high temperature [1, 2]. Many scholars paid their attentions to the welding characteristics of Inconel 718 alloy sheet [3-5]. However, with the development of industry, mid-thick Inconel 718 alloy plates were in larger demand [6]. Therefore, it was a great significance to obtain a weld bead of Inconel 718 alloy without defects. Laser welding process is attracting more and more attentions due to its excellent merits higher automation, smaller welding deformation and higher cooling rate [7, 8]. Nevertheless, a full penetration for mid-thick Inconel 718 alloy plates is hard to be obtained during laser welding process due to its low absorption of laser beam energy resulting from the existence of plasma. In order to weaken this disadvantage effect of plasma and improve the effective absorption rate of laser beam energy, many scholars made lots of