THE EFFECT OF SHIELDING GAS FLOW RATE ON FIBER LASER WELDING OF BORON STEEL

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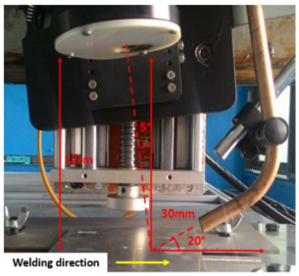
Graphical abstract



Abstract

During laser welding process, the ionized metal vapor from keyhole surrounding by molten metal mixes with the shielding gas and forms a plasma plume over the molten pool. The small amount of plasma plume is needed to react with molten pool by enhancing the absorption of laser energy thus increase the penetration. However, high amount of plasma will absorb the beam energy and this could decreases the penetration depth. The small wavelength of laser beam such as fiber laser, reported has less influence to plasma plume compared to bigger wavelength such as CO2 laser. However, even though using small wavelength laser, the laser beam with welding speed below 17mm/s had to go through the plasma plume over the molten pool. The suppression of plasma plume is highly influenced by shielding gas setup and flow rate. In this study, the effect of shielding gas flow rate (Argon) on CW and PW mode on low power fiber laser welding of Boron steel (22MnB5) was investigated. The observation of welding surface, width and depth were carried out. The width and depth pattern of CW and PW were slightly different. The range of 10-20L/min shows the widest width and 15L/min shows the deepest penetration for both welding mode.

Keywords: Boron Steel, laser welding, Fiber laser, Shielding gas

Abstrak

Semasa proses kimpalan laser, wap logam terion dari lubang kunci yang dikelilingi oleh logam lebur bercampur dengan gas pelindung dan membentuk kepulan plasma di atas kolam lebur. Jumlah kecil kepulan plasma diperlukan untuk bertindak balas dengan kolam lebur bagi meningkatkan penyerapan tenaga laser seterusnya meningkatkan tahap penembusan. Walau bagaimanapun, jumlah plasma yang tinggi akan menyerap tenaga alur ini dan boleh mengurangkan kedalaman penembusan. Panjang gelombang alur laser yang kecil seperti laser gentian, dilaporkan mempunyai kesan yang kecil tehadap kepulan plasma berbanding dengan panjang gelombang yang lebih besar seperti laser CO2. Walaupun, menggunakan laser gelombang kecil, pancaran laser dengan kelajuan kimpalan di bawah 17mm/s terpaksa melalui kepulan plasma di atas kolam lebur. Penindasan kepulan plasma sangat dipengaruhi oleh persediaan gas pelindung dan kadar alirannya. Dalam kajian ini, kesan kadar aliran gas pelindung (Argon) pada mod CW dan PW laser gentian terhadap kebolehkimpalan keluli Boron (22MnB5) telah dikaji. Pemerhatian pada permukaan kimpalan, lebar dan kedalaman hasil kimpalan telah dijalankan. Corak bagi lebar dan kedalaman hasil kimpalan untuk CW dan PW mempunyai sedikit perbezaan. Julat kadar aliran gas 10-20L / min menunjukkan kelebaran kimpalan yang paling tinggi dan kadar aliran gas15L / min menunjukkan penembusan kimpalan yang paling tinggi untuk kedua-dua mod kimpalan.

Kata kunci: Keluli Boron, kimpalan laser, Fiber laser, gas pelindung