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CRITICAL ASSESSMENT OF METALLURGICAL AND MECHANICAL CHARACTERISTICS OF PULSED LASER WELDED (α+β) PHASED Ti-ALLOY

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ABSTRACT

Thermo-metallurgical-mechanical performance of Ti-alloy welded structure highly influenced by non-uniform temperature gradient and associated cooling rate. In the present work, it is attempted to study the influences of optimized pulse parameter by considering variation in focal distance, on thermo-metallurgical and assisted mechanical behaviour pattern. Pulse duration of 8 ms is found to inferior process condition since, insufficient depth of penetration is observed for the present case whereas full depth of penetration is obtained at 10 ms. Consideration of defocusing distance i.e. -0.5 mm enhances the local cooling rate within the molten zone due to divergence of laser beam at a same power density. Gray blocky martensite within coarsened β -grain boundary is observed at higher heat input of 18 J/mm however fine and relatively smaller grain with acicular α^'-martensite is revealed for lowest heat input of 9.6 J/mm. Lower level of contamination is attained at lowest heat input is confirmed by the surface discoloration technique. Despite weld metal fabricated at minimum heat input, rendered poor mechanical properties than that of higher heat input. It might be due to insufficient depth of penetration owing to application of less heat input. Acicular α^'-martensite accompanied by highest cooling rate attained higher hardness rather than Gray blocky martensite accompanied by lower cooling rate.

Keywords: Ti-6Al-4V alloy, pulse laser welding, mechanical properties, phase transformation, morphological study, hardness distribution.