AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
Design and Production Engineering

Influence of laser welding parameter on the welded joints' quality and mechanical performance of Aluminum-Ceramic Particulate MMCs

A Thesis submitted in partial fulfillment of the requirements of the degree of

Master of Science in Mechanical Engineering

(Design and Production Engineering)

By

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Bachelor of Science in Mechanical Engineering
(Design and Production Engineering)
Faculty of Engineering, Ain Shams University, 2014

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Prof. Dr. Khaled Mahmoud Abd El-Ghany

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Statement

This thesis is submitted as a partial fulfillment of Master of Science in Mechanical Engineering, Faculty of Engineering, Ain shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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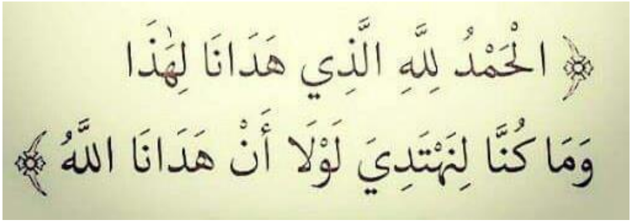

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Abstract

Metal Matrix Composite (MMC) is rapidly becoming prime candidates as structural materials in engineering as well as in electronic application. However, their usefulness is limited by the ability to manufacture products made from these materials, where laser welding is important. The objective of this work is to find the optimum laser welding parameters of AlSiCp MMCs strips. For this purpose, butt welding of 1.2 mm thin strips of Al6063- 5 and 10% vf SiC particulates, was conducted applying Nd:YAG laser beam welding. Laser beam diameter was 0.4 mm while a range of laser powers from 2000 W to 2500 W and welding speeds from 4 m/min to 9 m/min were used. The quality of the weld line is examined by micrographic investigation of weld pool geometry, keyhole induced pores, and SiCp distribution in weldpool. The strength of the welded joint is indicated by tensile testing of 3 mm width welded strips. For full penetration of welding, a minimum power of 2000 W. was required. The influence of the welding parameters is presented by drawing the trend lines relating penetration, porosity, weldpool width, and tensile strength, vs. welding parameters. A simulation model was built in comsol Multiphysics® in order to find the temperature distribution in the weldpool. Pores are mainly formed in the agglomeration areas of SiCp and at high laser power, and low welding speeds which significantly affect the mechanical properties of the welded sections. The formation of the undesirable Al4C3 compound in the fusion zone is studied along with its effect on the tensile strength of the specimens. In the end, good quality welded sections were achieved for both volume fractions with an ultimate tensile strength of 188.5 MPa, and 233.5 MPa for the 5 and 10% vf respectively. Optimum parameters are deduced based on these outcomes.

Keywords:

laser, MMC, welding, SiC, porosity, weldpool.

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1 Introduction