شبكة المعلومات الجامعية

بسم اللّه الرحمن الرحيم

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم باللّه العظيم أن المادة التي تم توثيقها وتسجيلها علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

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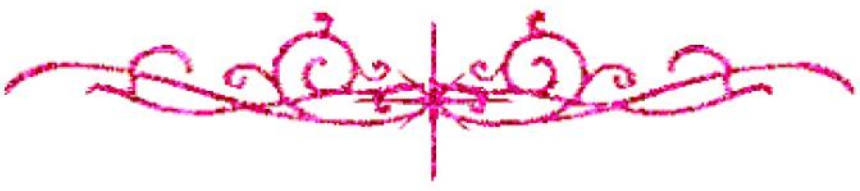

بالرسالة صفحات
لم ترد بالأصل

AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
Design and production Engineering

Surface Improvement of a Metallic Alloy using Friction Stir Processing (FSP)

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

Master of Science In Mechanical Engineering

(Design and Production Engineering)

By

Sara Essam Abd El-Sattar

Bachelor of Science in Mechanical Engineering

(Material Engineering)

Faculty of Engineering, Ain Shams University, 2013

Supervised By

Prof. Dr. Taher Gamal El-Din Abu El Yazid

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Dept. of Design & Production Engineering, Ain Shams University

Cairo - (2010)

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Date: 6/10/2020

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Date: 6/10/2020

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.

Signature

……...…….

Sara Essam Abd El-Sattar

Date: 6/10/ 2020

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Thesis Summary

Friction stir welding (FSW) is a process which can be used to join aerospace aluminum alloys and other alloys which can't be joined with conventional welding, also it is energy efficient, and environment friendly. Friction Stir processing (FSP) was developed based on the same principles of friction stir welding (FSW) mainly to enhance the surface properties of various materials to produce surface composites, and also increases strength having fine and homogenous grain structures.

Two types of aluminum alloy were used in this work AA7075 and AA5083, coarse particle sized Al_2O_3 and ultrafine sized SiO_2 particles were used as reinforcement of surface composite, Extensive preliminary work has been conducted to determine the effect of various processing parameters on the surface composite quality. These parameters include tool geometry, rotational speed, traverse speed, and groove dimensions.

In addition, different machines were used to optimize these parameters (e.g. milling machine and CNC machine). So finally AA7075 was reinforced with ultrafine size SiO_2 particles to prepare either surface composite or double surface (i.e. sandwich) composite. And also, AA7075 hybrid surface composites were prepared using ultra- fine size SiO_2 and Al_2O_3 particles with different mixing ratios. These surface composites were developed using FSP parameters; rotational speed of 600 rpm, traverse speed of 50 mm/min and 3 degrees tilt angle. A groove of 3 mm depth and 1.2 mm width was made on the surface of matrix. Different tool pin profiles (e.g. cylindrical and square) were used. These tools were made from K110 tool steel also were heat treated to both HRC 45 and HRC 60. The previous mentioned work was conducted on friction welding machine at the friction stir welding and processing laboratory at Suez University.

The developed surface(s) composites were being evaluated using different techniques to investigate the macro and micro features.

Surface hardness for the developing composite layer increased by 15% to 35% compared to unprocessed base metal. The groove dimensions provide the highest reinforcement volume fraction on the produced surface composites, also the tool dimensions and geometry gave good surface without any defects, however the squared profile enhanced the reinforcement distribution better than

cylindrical one. Moreover, Number of processing paths have effect on surface composite where the most uniform surface composites achieved by three consecutive paths. The hybrid surface (SiO_2 and Al_2O_3 particles/ AA7075) composites showed enhancement in particle distribution composites and microhardness measurement compared to AA7075/ SiO_2 surface composites especially 20% SiO_2 and 80% Al_2O_3 . In sandwich material the hardness distribution horizontally is uniform. The current results are consistent with those from other similar composites reported in the literature.

Keywords: Friction stir processing, Surface composite, Double surface composite (sandwich), Hybrid composites, Microhardness, Aluminum alloys.

Contents