AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
Design and Production Engineering

Assessment of Some Al Alloy Casting Produced by Special Casting Technique

A Thesis submitted in partial fulfillment of the requirements of the degree of
Master of Science in Mechanical Engineering
(Design and Production Engineering)
by

Hassan Mohamed Tiwery

Bachelor of Material Science and Metallurgy Engineering

Faculty of Engineering, Tripoli University 1990

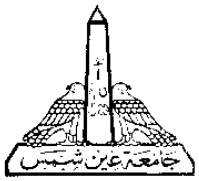
Supervised By

Prof. Adel Badawy EI-Shabasy

Prof. Iman Salah El din El-Mahallawi

Dr. Eng. Wael Fathy Hodiefa

Cairo - (2018)



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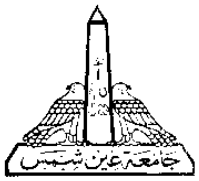
29 / 3 / 2018



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29 / 3 / 2018

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

……...…….

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ACKNOWLEDGEMENT

All thanks and indebted first, to Allah, who guided and helped me to go through and finish this work.

I would to express my appreciation and gratitude to the supervisors **Prof. Dr. Adel Badawy El- Shabasy & Prof. Dr. Iman Salah El–Mahallawi & Dr. Wael Fathy Hodiefa** for their sponsorship, enthusiastic guidance and valuable discussions.

My cordial second thanks are due to his Excellency **Dr. Wael Fathy Hodiefa** supervisor casting lab of Mining & Petroleum Dep. Faculty of Engineering. Al-Azhar University, his generous assistance in facilitating equipment, laboratories and encouraging me to complete this thesis and all support during the experimental work.

My great appreciation for **all the member** of labs metallurgy & petroleum Dep. Faculty of Engineering. Cairo University for their help and support during the experimental work.

My thanks **the Regional for Center of Mycology and Biotechnology**, Azhar University, Cairo, Egypt. For SEM & TEM, and also **Eng. Youssef Ali** in mechanical & production Dep. Faculty of Engineering. Cairo University.

All my love and gratitude are due to my **Mother**, **Wife and my Children**. I'm really appreciated their kindness and creating a good atmosphere during this study.

ABSTRACT

The main objective of this work is to study the enhancement of microstructure & mechanical properties of A356/ZrO_2 Metal Matrix nano composites. For completing such study different treatments were executed for the additives at different volume fraction using stir casting technique. Also heat treatment affected the fabricated composites was studied.

Recent investigation has-been divided into three parts:

Part I: This section describes the effect of using different nanoparticles feeding routes (direct, capsulate & regular) treatments of nanoparticles (as additives) on the microstructure and mechanical properties of A356 alloy.

A number of cast samples of A356 alloy were prepared by rheo-casting in a specially designed and built resistance furnace unit allowing feeding ZrO_2 nano- particles (30nm) in to the slurry in the semi-solid state with mechanical stirring at constant parameter (temp stirring 595-610°C, stirring speed 670 r.p.m at stirring time 2 minute).

Part II: This section presents the effect of different weight% of nano particles addition (1%, 2%, 3%, 4% & 5%) on the microstructure and the mechanical properties of the nano ZrO_2 reinforced A356 cast alloy.

Part III: This section presents the results obtained in this work for the microstructure and mechanical properties of capsulate feeding 3% ZrO_2 nanoreinforced A356 alloy with compare to monolithic cast A356 alloy in T6 heat treated condition. The samples were solution treated at temperature of 550°C for 2 hours, followed by aging at different temperatures (170°C&180°C), for different aging times (2, 4 & 6 hours).

The results showed that microstructure of the nano composite samples revealed grain refinement in aluminum matrix support dendrite and inter lamellar spacing in the eutectic silicon phase for the nano composite ZrO_2 .The capsulate treated feeding at 3% ZrO_2 alloy has the best mechanical properties (Strength 165MPa, %Elongation 4.7& Hardness 60 HRB), compared to monolithic cast alloy (Strength 119MPa, %Elongation 4.5& Hardness 23 HRB). The heat treatment T6 produced for capsulate feeding 3%ZrO_2 Alloy result has better than monolithic casted alloy (Strength from 119MPa to 198MPa, %Elongation from 4.5 to 6,4 , Hardness from 23 to 70 HRB), an effective change on morphology of the eutectic silicon lamellae. More details discussed using SEM and EDX analysis.

The nano-composites exhibited better mechanical properties when compared with the A356 monolithic alloy, also the addition of 3% ZrO_2 nanoparticles, and heat treated T6 process has the best result in mechanical properties.

Key words:

Aluminum alloy, stirring casting, ZrO_2 nanoparticles, strength, hardness, heat treatment.

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LIST OF FIGURES