



Ain Shams University  
Faculty of Education  
Physics Department

# **Study of Structural and Mechanical Properties of Al-5356 Solder Alloy**

**Thesis**

*Submitted for  
the Degree of Doctor of Philosophy for the  
Teacher's Preparation in Science (Physics)*

By

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Ain Shams University*

**2010**

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**Title** : Study of Structural and Mechanical Properties of  
Al-5356 Solder Alloy  
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**Degree** : Doctor of Philosophy Degree for the Teacher's  
Preparation in Science (Physics).

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Date of presentation / / 2010

Post graduate studies :

Stamp : / /

Date of approval : / /

Approval of Faculty Council : / /2010

Approval of University Council : / / 2010



**Ain Shams University  
Faculty of Education  
Physics Department**

**Thesis Title**

**Study of Structural and Mechanical  
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**ABSTRACT**

**Name** : Essam Mohammed Nassr El Den  
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of Al-5356 Solder Alloy  
**Submitted to** : Physics Department, Faculty of Education, Ain  
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The present work is devoted to investigate:

(1) The effect of grain diameter and deformation temperature on the stress-strain characteristics of Al-5356 wire samples under constant strain rate (S.R) of  $1.5 \times 10^{-3} \text{ s}^{-1}$ .

(2) The effect of ageing time on the stress-strain characteristics of Al-5356 wire samples strained at different deformation temperatures ranging from 303 to 523 K under constant strain rate of  $1.5 \times 10^{-3} \text{ s}^{-1}$ .

(3) The effect of  $\gamma$ -irradiation with different doses (D) ranging from 500 to 2000 kGy on the stress-strain characteristics of Al-5356 samples strained by strain rate of  $1.5 \times 10^{-3} \text{ s}^{-1}$  at different deformation temperatures ( $T_w$ ).

(4) The structural changes accompanying both grain growth and ageing processes using optical and scanning electron microscopy (SEM) in addition to the energy dispersive X-ray spectroscopy (EDS) and X-ray diffraction (XRD) investigations.

## ABSTRACT

In view of the microstructure and subsequently the stress-strain parameters variation, the obtained results showed that:

a) Increasing grain diameter of the tested sample resulted in decreasing the work-hardening parameters (WHP) yield stress  $\sigma_y$ , fracture stress  $\sigma_f$ , total strain  $\epsilon_T$  and work-hardening coefficient  $\chi_p$ .

b) Serration amplitude was found to be inversely proportional to the increase in grain diameter.

c) The total strain  $\epsilon_T$  decreased with increasing the grain diameter while increasing the deformation temperature exhibited minimum value at 348K.

d) The WHPs  $\sigma_y$ ,  $\sigma_f$  and  $\chi_p$  increased with increasing the ageing time, while  $\epsilon_T$  decreased.

e) The WHPs  $\sigma_y$ ,  $\sigma_f$  and  $\chi_p$  increased with increasing the irradiation dose D, while  $\epsilon_T$  decreased.

f) The Deformation temperature exhibited a reverse effect of  $\gamma$ -irradiation.

## **ACKNOWLEDGEMENT**

The author is greatly indebted to **Prof. Dr/ Madiha Fadel Abd-El Aal**, Head of Physics Department, Faculty of Education, Ain Shams University, for her continuous support.

I would like to express my deep gratitude to **Prof. Dr/ Gamal Saad Awadalla**, Physics Dpt., Faculty of Education, Ain Shams University, for suggesting this work and for his continual support, moral encouragement, and relentless efforts to make this work come to life.

Grateful thanks to **Prof. Dr/ Sanaa Ahmed Fayek**, Physics Dpt., National Center for Radiation Research and Technology, for her kind help and suggesting the part of radiation included in this work.

Sincere appreciation to **Prof. Dr/ Adel Fawzy**, Physics Dpt., Faculty of Education, Ain Shams University, for his continual support, help and valuable discussions through the present work.

Thanks are also extended to **Dr/ Hany Nazmy Soliman**, Physics Dpt., Faculty of Education, Ain Shams University, for his kind help and valuable discussions throughout the progress of this work.

This work has been performed in the laboratory of "Solid State Physics", Faculty of Education, Ain Shams University, and I would like to express deep thanks to my colleagues at the laboratory for the experimental facilities they have provided. Also many thanks for the staff of National Center for Radiation Research and Technology for providing many experimental facilities.

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