THE EVALUATION ON THE EFFECT OF AGING TO THE INTERFACIAL BONDING OF PCB SOLDERED USING SAC305

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Final Report II

Projek Sarjana Muda

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DECLARATION

I declare that this project report entitle “The mechanical properties & microstructural analysis of welded DPS in compliance to a selected international standard” is the result of my own except as cited in the references

Signature :.....

Name :.....

Date :.....

APROVAL

I hereby declare that I have read this project report and in my opinion this report is sufficient in term of scope and quality for award of the degree of Bachelor of Mechanical Engineering (with Honours)

Signature :.....

Name of Supervisor :.....

Date :.....

SUPERVISOR'S DECLARATION

I have checked this report and the report can now be submitted to JK-PSM to be delivered back to supervisor and to the second examiner.

Signature :.....

Name of Supervisor :.....

Date :.....

DEDICATION

This report is dedicated to

Muhammad Shukri Bin Jaafar

Nik Salida Harlina Binti Nik Saleh

Muhammad Ziyad

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ABSTRACT

Soldering materials show evolving microstructure and mechanical behaviour that exponentially changes with environmental impacts such as isothermal aging and thermal cycling. Mechanical measurements of thermal aging effects and material behaviour development of lead-free solders were performed in the current study. For lead-free solders, 96.5Sn-3.0Ag-0.5Cu (SAC305) was characterized by isothermal aging effects and viscoplastic material developmental evolution. Isothermal aging has been performed at high temperatures (100ºC, 120ºC, 140ºC, 160ºC, 180ºC and 200ºC) in our total experimental program. In this paper, we focused on reporting the results of experiments resulting in temperature aging. Variations in temperature thermal aging dependent mechanical properties (micro hardness, electron microscope scanning, wettability and optical microscope) were observed and modelled as a function about 3-hour. Microstructural changes were also recorded for the solder alloys during the six temperature aging process and correlated with the observed changes in mechanical behaviour.

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TABLE OF CONTENTS

LIST OF TABLE

LIST OF FIGURES

LIST OF ABBEREVATIONS

Sn	Stannum
Ag	Argentum
Cu	Copper
Pb	Lead
Au	Aurum
Bi	Bismuth
SAC	Tin, silver and copper
PCB	Printed Circuit Boards
IMC	Intermetallic compound
OM	Optical microscope
SEM	Scanning Electron Microscope
SMD	Surface mounted devices
IR	Infrared
NEMI	Electronics Manufacturing Initiative
TM	Melting temperature
ENIG	Electro less nickel immersion gold

LIST OF SYMBOL

T	=	Temperature
°C	=	Degree Celsius
µ	=	Micro
F	=	Farad

CHAPTER 1

INTRODUCTION

1.1 Background

These are quite a number of joining methods concerning microelectronics industry such as soldering, gold-to-gold interconnection and conductive film bonding. However, the versatility of soldering makes it a very commonly used and favourable joining technique for interconnections and packaging for electronics assembly. It conducts electricity between component leads and conducting wires or tracks on a printed circuit board. Solder is a metal substance having a low liquefying purpose of around 200℃. Solder is highly utilized in the electronic packaging industry to build up an electrical association between parts in the circuit by utilizing liquid metal and a soldiering iron. Solders are additionally utilized in electronic gadgets and regularly defrost at temperature underneath 350℃. (Ervina Efzan, 2015).

Printed Circuit Boards (PCB) are a basic part in relatively every electronic device. Hardware occur in an assortment of shapes and sizes which is dictated by capacity, condition and physical shape; in any event the physical gadget arrives in an assortment of shapes. The electronics part of the appliance is restricted to a standard 2.5 D approach. A printed circuit board mechanically support and electrically connects electronic components using conductive tracks, pads and other features etched from copper sheets laminated onto a non-conductive substrate. PCBs can be single sided (one copper layer), double sided (two copper layers) or multi-layer. Conductors on different layers are connected with plated-through holes called vias. Advanced PCBs may contain components - capacitors, resistors or active

devices - embedded in the substrate. (Church, 2013). The heating of the PCB fabrication must be a controlled procedure, ready to oblige segments and materials. They are four operations of the reflow profile and these segments comprise of preheat, pre flow, reflow and cooldown. (Phill Zarrow, 1990).

Tin-lead solder compounds are utilized broadly in the microelectronic manufactures. The use of tin-lead ended up well known because of its low value, high wetting properties and normal melting point temperature. However, due to the environment based legislation imposed on the usage of Tin-lead solder, efforts have been made for a Lead-free solder joint with tin silver-copper system being the most commonly used in the microelectronics industry. Tin silver-copper (Sn/ Ag/Cu) solder is generally known by the acronym "SAC". SAC solder is by and large considered as eutectic or about eutectic at a temperature of right around 217°C. Mostly, the scope of the arrangement of SAC compounds is from 0.5 to 0.8% for copper, 3.0 to 4.0% for silver, and the other remains of the arrangement is a Sn composite. (Pan, Jianbiao Wang, Jyhwen Shaddock, David M, 2005) and (Ervina Efzan, 2015)

Apart from providing the connecting and maintain its conductivity throughout the assembly, it also maintains the mechanical integrity of the solder joint. This integrity of solder joints affects the performance and the overall functioning of the assembly. The usage of electronic device has been very demanding at a considerably long period of time. This phenomenon creates thermal aging and also fatigue on the solder joint, leading to decreasing of the life span of the products. This long term reliability of solder joints is closely related to the microstructural evaluation of the intermetallic compounds (IMC) layer that formed through the migration of atoms during the reflow process with the application of heat without a thorough understanding of how the formation of IMC correspond with the aging time there are possibly that it will, lead to the failure of the solder joint.

1.2 Problem Statement

Exposing the lead-free solder joint to a temperature at considerable period can cause thermal fatigue and leave the solder joint point to corrosion which leading to failure of the joints and most probably the electronics. This long term reliability of the SAC system solder joint that subjected to thermal aging temperature of 100ºC, 120ºC, 140ºC, 160ºC, 180ºC and 200ºC has been associated with the formation and the characteristics of the IMC layer. This studies has been done with respect to this area but result that looks on the interfacial layer of the solder joint is still lacking.

In this particular project, the effect of thermal aging on the microstructure evolution and solder joint reliability of SAC 305 on the PCB will be investigated

1.3 Objective

The objectives of the project are as follows:

1. To determine the effect of aging temperature on the migration of copper at interfacial layer of soldering PCB.
2. To characterise the morphological aspect of the IMC developed after aging using SAC305.

1.4 Scope

The main concern in this project is to determine the effect of aging time if the migration of copper of interfacial layer of soldering PCB by looking at the microstructural evolution using optical microscope (OM) and scanning electron microscope (SEM) and to

characterise the IMC after aging using SAC305. A sample preparation will be done through metallography preparation, including mounting, grinding and polishing. The other characterization method would be sessile drop contact angle, micro hardness test and surface texture measurement.

CHAPTER 2

LITERATURE RIVIEW

2.1 Introduction to Soldering

Soldering is a method used for joining steel parts to form a mechanical or electrical bond. It commonly makes use of a low melting point steel alloy (solder) which is melted and applied to the steel parts to be joined and this bond to the metal parts and types a connection when the solder solidifies. However, most metals exposed to the atmosphere accumulate a thin film of tarnish or oxidize the longer the publicity the thicker the film will be. This film exists even although it is not visible. A soldering flux with a melting factor decrease than the solder should be used to "wet" the steel and enable the solder to penetrate it and remove the film. The flux melts first, getting rid of the tarnish or steel oxide, and also preventing in further oxide from forming while the steel is being heated to soldering temperature. The solder then melts, floating the lighter flux and the impurities suspended in it to the outer surface and edges of the molten fillet. The solder cools and forms an alloy with the metal. Most of the flux is burned away at some point of the soldering process; any residue is removed by using fabulous cleansing methods. (Wiring and Sect, 2002). Solders are also used in electronic devices and commonly thaw at temperatures under 350°C. Eutectic solder consists of 37% lead (Pb) and 63% tin (Sn). Generally, it is recognized as 63/37 solder and is desired as when it is melted, it adjustments right away from solid to liquid state. (Ervina Efzan and Siti Norfarhani, 2015).