UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Faculty of Manufacturing Engineering

BONDABILITY AND RELIABILITY STUDY ON VARIOUS SILVER PLATED COPPER LEADFRAME WITH 25μm WIRE DIAMETER OF GOLD AND COPPER WIRE

NG SHAY LEE

Master of Manufacturing Engineering
(Manufacturing System Engineering)

2016

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BONDABILITY AND RELIABILITY STUDY ON VARIOUS SILVER PLATED COPPER LEADFRAME WITH 25μm WIRE DIAMETER OF GOLD AND COPPER WIRE

NG SHAY LEE

A thesis submitted
in fulfillment of the requirements for the degree of Master of Manufacturing Engineering (Manufacturing System Engineering)

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- hereinafter referred to as "**Recipient**"

and

Infineon Technologies (Advanced Logic) Sdn. Bhd. (542606-T)
with office at Free Zone, Batu Berendam, 75350 Melaka, Malaysia
- hereinafter referred to as "**Infineon**"

- both may hereinafter be referred to as "**Party**" or "**Parties**"

Effective Date: 1st April 2014

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WHEREAS, Infineon intends to engage in collaboration with the Recipient concerning the Master Project on " Bondability And Reliability Study On Various Silver Thickness Plated on Copper Leadframe With 25um Wire Diameter Of Gold And Copper Wire" by Ng Shay Lee (791227-04-5312) as a Master of Manufacturing Engineering (Manufacturing Systems) degree project ("Purpose");

WHEREAS, in the course of such discussions and other activities (which may include line visits, presentations as well as the supply of services), it is anticipated that Infineon will disclose to the Recipient certain Confidential Information (as defined below) for the Purpose as set forth above;

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IN WITNESS WHEREOF, the Parties have caused this Agreement to be executed by their duly authorized representatives on the dates specified below.

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DECLARATION

I declare that this thesis entitled "Bondability And Reliablity Study On Various Silver Plated Copper Leadframe With 25μm Wire Diameter of Gold and Copper" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : .....

Name : NG SHAY LEE

Date : 24 February2016

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APPROVAL

I hereby declare that I have read this dissertation/report and in my opinion this dissertation/report is sufficient in terms of scope and quality as a partial fulfillment of Master of Manufacturing Engineering (Manufacturing System Engineering)

Signature :.....

Supervisor Name : ASSOCIATE PROFESSOR DR.NUR IZAN SYAHRIAH BINTI HUSSEIN

Date : 24 February2016

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DEDICATION

This thesis is dedicated to my family and friends.

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ABSTRACT

Silver spot plated copper leadframe play very importance role in semiconductor industry. Throughout the semiconductor industry intense economic competition has stimulated interest in the area of package cost reduction per year function over the range of products it offers. In an attempt to meet the demand packages cost down, semiconductor has to find an alternative solution from packaging where manufacturing efficiencies such as cycle time reduction, supply chain management and yield improvement allow for continued reductions in the cost to achieve lowest manufacturing cost. In order to development of a new thickness silver spot plated copper leadframe involves a wide variety of issues which must be addressed. Example characterization was made in the areas of leadframe material with the molded package. However, the characteristic of thickness silver plated on copper leadframe towards bondability and reliability is not studied in depth. In this research, evaluation will be performed to study the bondability and reliability on various thickness of silver plated copper leadframe with 25μm wire diameter of copper and gold wire. Relative average plating thickness of the leadframe surface will be measured prior to the evaluation. Leadframe with 3 different silver plated thicknesses and 25μm wire diameter on gold wire and copper wire will be used for each evaluation. Therefore, in bondability process, wedge pull test on lead will be collected during this study to check the correlation between 2nd bond quality and silver plated thickness. The shear test will be performed in order to find out the relationship between the mechanical strength of the ball and the characteristics of the electroless silver layer deposited. The wedge integrity after stress will be investigated through extreme temperature of Temperature Cycle (TC) test.

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ABSTRAK

Leadframe yang bersalut perak memainkan peranan yang penting dalam industri semikonduktor. Dalam industri semikonduktor, persaingan ekonomi yang sengit telah merangsang setiap industri menurunkan kos pakej mereka sepanjangan produk yang ditawarkan di pasaran. Dalam usaha untuk memenuhi permintaan pengurangan kos pakej, industri semikonduktor terpaksa mencari penyelesaian alternatif dari pembungkusan di mana keberkesanan pengilang seperti pengurangan kitaran masa, pengurusan rantaian bekalan dan peningkatan hasil produk untuk membolehkan penurunan kos berterusan untuk mencapai kos pembuatan yang rendah. Dengan mencipta ketebalan leadframe yang bersalut perak yang baru, pelbagai isu perlu ditangani. Sebagai contoh, ciri-ciri dari bidang pembuatan leadframe sehingga ke pakej siap. Walau bagaimanapun, bondability dan reliability ketebalan perak yang disalut pada leadframe tidak dikaji secara mendalam. Dalam kajian ini, kajian akan dilaksanakan untuk mengkaji bondability dan reliability pelbagai ketebalan perak bersalut pada leadframe dengan 25μm wayar diameter untuk tembaga dan emas. Ketebalan perak pada permukaan leadframe akan dinilai dan dikira secara purata sembelum memulakan kajian. 3 jenis ketebalan perak pada permukaan leadframe akan digunakan bersama dengan 25μm diameter wayer tembaga anda emas dalam setiap kajian. Oleh itu, dalam process bondability, ujian wedge pull pada kaki leadframe akan diukur semasa kajian dijalankan. Tujuan ini adalah untuk memeriksa korelasi diantara bond kualiti dan ketebalan perak disalut pada leadframe. Wedge intergrity selepas tekanan suhu akan diukur melalui ujian kitaran suhu (TC).

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CHAPTER 1

INTRODUCTION

This chapter gives an overview of the research to be studied. It includes background, problem statement, objectives, scope, timeline and significance of the study.

1.1 Background

Infineon Technologies Sdn Bhd is the largest semiconductor manufacturing sites in Melaka. The company has established itself as a leading manufacturing site for Discrete, Power, Logic and Sensor products. Logic product is being driven by four mega trends that are helping shape our society: Energy Efficiency, Mobility and security and offers semiconductors and system solutions for automotive and industrial electronics and security application.

Infineon Technologies products stand out for their reliability, quality excellence and innovative and leading edge technology in analog and mixed signal, radio frequency (RF) and power as well as embedded control. It commit to produce high quality of the products to customer due to the products is used in automotive, safety, security and infrastructure fixture.

Base on the Total Cost Reduction (TCR) year 2013, Figure 1.1 shows the direct materials consist of 65% from the overall. From the 65%, gold wire (Au) contributed 32%, leadframe 16%, mold compound 9%, glue 3%, galvanic 3% and tray 2%.

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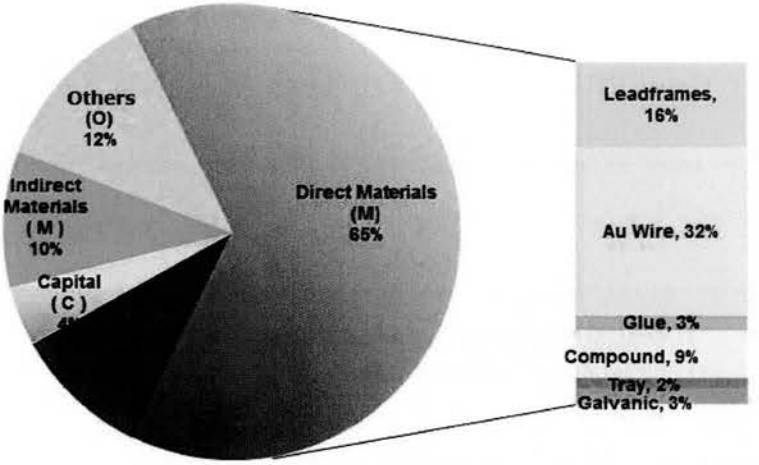

Figure 1.1: Pi Chart of TCR year 2013 (Infineon, 2013)

Pi chart as in Figure 1.1, potential research select for cost reeducation or improvement is migrate all gold wire to copper wire and reduce the leadframe consumption. Every year RM 110000K had been invested on leadframe material to support business. In conjunction to, management has interest on feasibility study of reducing silver plating thickness without impact on the quality on bondability and reliability on the product.

Figure 1.2 shows that 80% of the leadframe types used is copper base leadframe. While alloy and µppf leadframe are 16% and 4% respectively, Therefore, copper base leadframe is the focus leadframe.

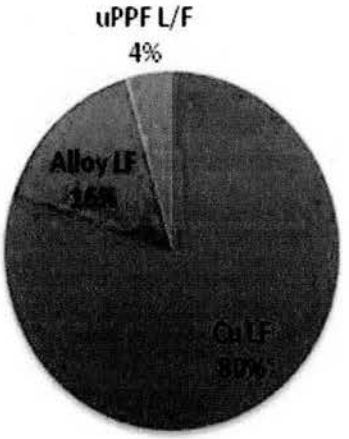

Figure 1.2: Leadframe catergories (Infineon, 2013)

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Current average silver plating thickness provide by supplier is 8μm, whereby the specification for silver plating thickness is 4-12μm. From Figure 1.3, Shinko has the thickest silver plated on leadframe which the average range is 8μm. While the thinnest silver plated average is 5.32μm from Rokko.

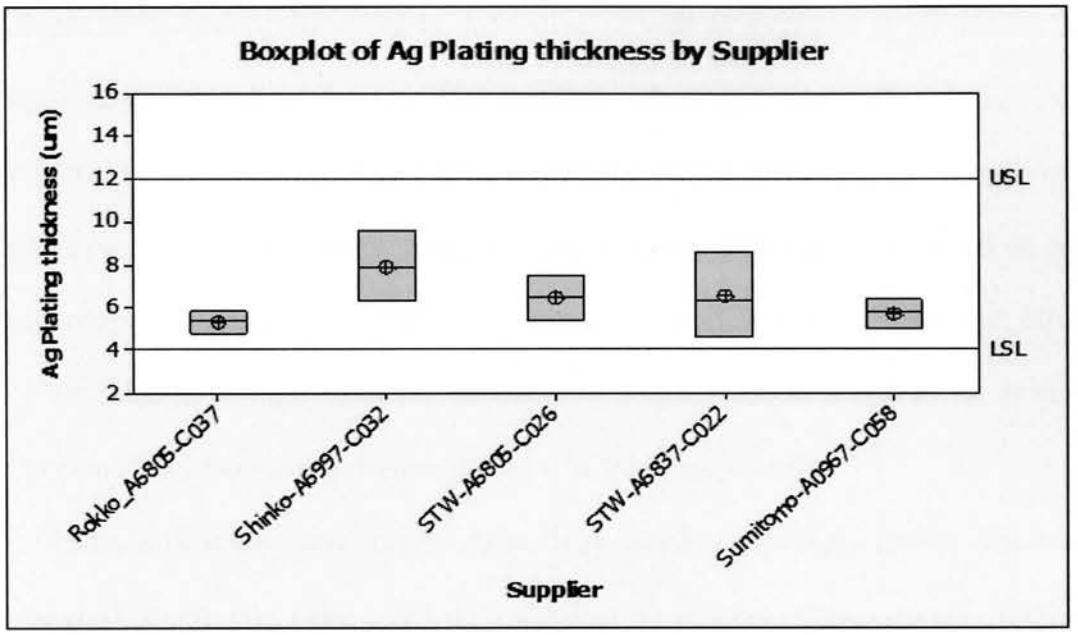

Figure 1.3: Boxplot of silver plating thickness by Supplier (Infineon, 2013)

Plating surface coating of a metal is deposited on a conductive surface. Plating has been done for hundreds of years; it is also critical for modern technology. Plating is used to decorate objects, for corrosion inhibition, to improve solderbility, to harden, to reduce friction, to improve paint adhesion, to alter conductivity, to improve infra-red (IR) reflectivity for radiation shielding and for other purposes.

Electroplating is one of the important processes in electronic industries. The purpose of electroplating process is to enhance the value of metal articles by improving their appearance. However, the importance of metal finishing for purely decorative purposes has decreased. Currently the trend is toward surface treatments which will impact corrosion resistance or particular physical or mechanical properties to the surface and

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