SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Bachelor of Engineering in Manufacturing Engineering.

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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MEASUREMENT OF CONTACT ANGLE OF SILICONE GLUE DROPLET ON CU SURFACE IN MEMS MICROPHONE PACKAGE

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Report submitted in fulfillment of the requirements
for the award of the degree of
Bachelor of Engineering in Manufacturing Engineering

Faculty of Manufacturing Engineering

UNIVERSITI MALAYSIA PAHANG

JUNE 2017

ACKNOWLEDGEMENTS

Foremost, I would like to thank God for his blessings during completing this research. Besides, I would like to express my sincere appreciation to my supervisor Dr. Nurrina Rosli for her continuous support and guidance throughout this study and research. Thank you for being patience, gives motivation, passionate and shares huge knowledge during the progress and completion of this research. I could not have imagined having a better supervisor for my research. In addition, my panels, Dr. Zamzuri Hamedon, Dr. Yazid Abu, and Dr. Mebrahitom Asmelash Gebremariam for their inspiration, insightful comments, and hard questions.

Last but not the least, I would like to thank my family and friends: my mother Saloma Minin, for giving birth to me at the first place and supporting me spiritually throughout my life.

ABSTRAK

Projek ini mengkaji tentang Pengukuran sudut kenalan (CA) atas permukaan tembaga (Cu) dalam Pakej MEMS mikrofon. Pengukuran CA adalah amat penting untuk menganggarkan kebolehbasahan gam silikon di atas permukaan Cu kerana ia boleh menjejaskan prestasi kelekatan gam silikon semasa proses meletakkan cip. Oleh itu, kajian asas ini bertujuan untuk mengkaji kesan bahan permukaan kering pada substrat Cu, jumlah isipadu yang berbeza dan masa pemendapan gam silikon untuk pengukuran CA dan untuk menganalisis CA yang menggunakan kaedah imej analisis dengan Adobe Photoshop dan ImageJ. Hasilnya, didapati bahawa CA menjadi lebih rendah dengan membersihkan menggunakan Aseton dan Etanol. Ini boleh dikaitkan dengan fakta bahawa pembersihan adalah satu kaedah untuk membuang bendasing organik. Selain itu, jumlah isipadu yang lebih kecil didapati mengurangkan CA. Di samping itu, lebih lama pemendapan masa yang boleh mengurangkan CA. Ini adalah kerana proses pembasahan berlaku apabila titisan mesin berkenaan. Tambahan pula, keputusan keseluruhan CA menggunakan Adobe Photoshop didapati lebih tepat berbanding ImageJ.

ABSTRACT

This project is studying on the contact angle (CA) Measurement on the Copper (Cu) surface in MEMS Microphone Package. The CA measurement is of great importance to estimate the wettability of the Silicon glue on the Cu surface as it can affect the adhesiveness performance of the Silicon glue during the die attach process. Hence, this fundamental study is aimed to investigate the effects of surface cleaning materials on the Cu substrate, different drop volume and time deposition of the Silicon glue to the CA measurement and to analyze the CA using image analysis method by Adobe Photoshop and ImageJ. As a result, it is found that the CA become lower by cleaning using the Acetone and Ethanol. This can be attributed by the facts that cleaning is a method to remove the organic impurities. Moreover, the smaller droplet volume was found to decrease the CA. Besides, the longer the time deposition can reduce CA. This is because of the wetting process occurred once the droplet is dispensed. Furthermore, overall results of CA using Adobe Photoshop is found to be more accurate compared to ImageJ.

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LIST OF SYMBOLS

d	Diameter
h	Height

LIST OF ABBREVIATIONS

BLT	Bond line thickness
CA	Contact angle
Cu	Copper

CHAPTER 1

INTRODUCTION

1.1 Introduction

The adhesiveness of a liquid on the material surfaces is the degree of the wettability of the liquid itself on the surfaces. The degree of wettability is important factor in the various industrial processes such as liquid coating, printing, lubrication, oil recovery and spray quenching (Prabhu, Fernades, & Kumar, 2009; Yuan & Lee, 2013; Zhao, Blunt, & Yao, 2010). In the semiconductor field, right after the die attach process; the bond line thickness (BLT) of the dies is measured. The purpose to measure the BLT value is to get the thickness of the Silicon glue. During designing the joint of the bond, BLT is become a significant factor that is need to be count of. Basically, the BLT of each die is measured as to ensure the adhesion of the Silicon glue is within the specification which is 25 microns to 60 microns. Generally, the parameters that is effect the adhesive performance are the adhesive properties, the substrate preparation of the surface, the BLT and the bond line uniformity. Furthermore, the bond line which is thinner is more preferable rather than the thick one since the concentration of the stress at the joint's corner is less. Besides, the concentration of the air cavity in the thinner bond line is less too. Moreover, the adhesiveness performance is strongly related to the wettability of the Silicon glue itself. In order to estimate the wettability of Silicon glue, a fundamental study of CA measurement is important. Therefore, this project is aimed to investigate the effect of surface cleaning materials on the Cu substrate, different drop volume and the time deposition of the Silicon glue on the Cu substrate to the CA measurement and to analyze CA of Silicon glue droplet on the Cu substrate using image analysis method by Adobe Photoshop and ImageJ.

1.2 Problem Statement

During the die attach process of the MEMS Microphone Package, some of the BLT's die is not within the thickness specification which is set as 25 to 60 microns. If the BLT is extremely thin or thick, it leads to defect of products in the packaging processes. This is due to the over stress and air cavity occurred in between the die and substrate during the dispensing of Silicon glue, the thickness of the Silicon glue depends on the adhesiveness performance of the glue which is effected by the wettability. Hence, to estimate the wettability, a fundamental experiment is conducted to measure the CA of Silicon glue droplet on the Cu surface. Parameters that involved during the fundamental experiment are surface cleaning materials, different drop volume and time deposition of the Silicon glue on the Cu substrate. The CA measurement is analyze using Image analysis method which are Adobe Photoshop and ImageJ.

1.3 Objectives

i. To investigate the effect of surface cleaning materials on the Cu substrate, different drop volume and the time deposition of the Silicon glue on the Cu substrate to the CA measurement.

ii. To analyse the CA of Silicon glue droplet on the Cu substrate using image analysis method by Adobe Photoshop and ImageJ.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter includes the pass researcher's methodology about the wettability, CA measurements, sessile drop method, and image analysis software in order to measure the CA of liquid on a solid substrate. Basically, wettability is the tendency of a liquid to spread over a solid substrate (Prabhu et al., 2009). Besides, the wettability can be classified by the rate of wetting and its degree (Frear, Jones, & Kinsman, 1991). The degree of wettability can be investigated when the surface is wet with liquid and CA is appeared at the three-phase interface. Furthermore, the rate of wettability is the speed of a liquid to spread all over a solid substrate. There are few parameters that influence the rate of wettability which are the texture of the surface, the substrate's temperature and the liquid medium's intrinsic properties (Prabhu et al., 2009). Hence, calculating the CA measurements will help to estimate the wettability of a certain liquid on a solid surface. Specifically, the CA is less than 90° is more favourable rather that higher than 90° (Yuan, Y., & Lee, T. R., 2013). It is because the less angle of CA measurements, fastest the liquid spread optimally all over the substrate.

2.2 Wettability

The intermolecular interactions between liquid and solid surface will affect the wettability. The adhesive and cohesive forces are the force that determined the degree of wettability. Besides, solid, liquid and gas is the three phases of material that will relate and deals to the wettability. The wettability is important to the adhesiveness and bonding of two materials. Furthermore, two types of wettability are including the non-reactive and the active one (Science, 2017; Hu et al., 2013). Moreover, the adhesive and cohesive forces will determine the CA. Because when the CA is decreasing it is affected by the

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