STRESS EFFECT ON BOND PAD AND TAB OF GOLD AND COPPER WIRES

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ACKNOWLEDGEMENTS

I would like to thank first and foremost my supervisor, Pn. Tuan Norjihan Bt Tuan Yaakub for her support mentally during my research work. I am extremely grateful for the guidance of my supervisor and her mentoring, encouragement and consistently helping me to get over several obstacles that I have come across during my research.

I would also like to thank my parents and my family members for their support and encouragement, without which it would not be possible for me accomplish the task. I would like to thank my best friends Azman, Hilmi and Noh. Thank you very much for being with me during my ups and downs and thanks for all your help.

Last but not least special of thanks dedicated to all members from Faculty of Electrical Engineering batch December 2009 – January 2013 and all lecturers who have involved directly or indirectly during the development of this project. Thank you and may Allah bless you.

ABSTRACT

This project is conducted using the explicit dynamics analysis, one of the analysis system under finite element method (FEM) to predict the stress behavior on free-air ball (FAB) of Au/Cu ball and Al bond pad during the impact stage in wirebonding process. Sometimes, there is a phenomena known as structural defect occurring on each of the FAB and the Al bond pad during the process at which each of these defects are caused by the factor of material behavior of the wire used in the process. From the founding of previous researchers regarding to the failure in wirebonding process, there are five types of major defects.

Two out of five of the major defects that usually occurred are ball crack failure and the cratering or mechanical damage on bond pad and underlying material. As an effort to overcome these defects, the explicit time integration scheme study is employed to investigate the effect of two different material properties which were the gold and the copper wires. The results for these two materials are compared.

The FEM regarding to the stress distribution on ball shows that the copper material has greater strength to compensate with the stress compared to the gold material as it has greater modulus of elasticity (Young's modulus) than the gold. The greater the modulus, the stiffer the material. As the copper ball is stiffer than the gold ball, the tendency of the copper ball to be cracked by the capillary is lower than the gold ball. But on the other part of the FEM regarding to the stress distribution on the Al bond pad, it shows that the copper has higher possibility to cause the cratering or crack on the Al pad and the underlay silicon die structure rather than the gold ball. Through this investigation, it is believed can help the manufacturers of semiconductor to choose which material is better to be used in wirebonding process, either the gold or the copper.

TABLE OF CONTENTS

DECLARATION iii

DEDICATION iv

ACKNOWLEDGEMENTS v

ABSTRACT vi

TABLE OF CONTENTS vii

LIST OF TABLES ix

LIST OF FIGURES x

LIST OF SYMBOLS AND ABBREVIATIONS xii

CHAPTER 1 **13**

1.1 INTRODUCTION 13

CHAPTER 2 **15**

2.1 LITERATURE REVIEW 15

CHAPTER 3 **16**

3.1 METHODOLOGY 16

3.1.1 Finite Element Method 16

3.1.2 Data gathering process 19

3.1.3 Data analysis procedure 21

CHAPTER 4 **23**

4.1 RESULTS 23

4.1.1 Stress distribution on ball 23

CHAPTER 2

LITERATURE REVIEW

2.1 LITERATURE REVIEW

Gold is the common material used in most of wirebonding process since its development almost 50 years ago in semiconductor manufacturing as it is flexible and reliable interconnect solution. Anyhow, the demand for lower-cost, smaller outline packaging, faster device performance, increased thermal dissipation, "clean" processes and higher device reliability by the manufacturers leads many researches to find alternative material that can be used to replace the gold at stage by stage or at all in the future. Several previous studies are conducted on stress yielded on the FAB of the wire and the structural of FAB itself using two type materials; gold and copper in order to investigate as if the copper can be used as the alternative material instead of using gold in wirebonding process.

Most of previous studies are concentrated either on the structural of FAB or on the structural of the underlay Al bond pad by controlling the parameters of wirebonder in both copper and gold wirebonding. But in this investigation; it is narrowed to impact stage of wirebonding. Regarding to the structural of underlay Al bond pad during wirebonding process, the research is conducted by observing the effect of stress produced by smashing FAB on the bond pad. The materials behaviour such as Young's modulus, shear modulus and tensile modulus play important roles as they can determine the condition of Al pad structure as the FAB is smashed by the capillary upon it.