CHARACTERIZATION OF INTERMETALLIC GROWTH IN GOLD BALLBONDS ON ALUMINUM METALLIZATION

LIM MOY FUNG

SCHOOL OF MICROELECTRONIC
ENGINEERING
UNIVERSITY MALAYSIA PERLIS
2007

CHARACTERIZATION OF INTERMETALLIC GROWTH IN GOLD BALLBONDS ON ALUMINUM METALLIZATION

by

LIM MOY FUNG

Thesis submitted in partial fulfillment
of the requirements for the degree of Bachelor
of Microelectronics Engineering

March 2007

ACKNOWLEDGEMENT

APPROVAL AND DECLARATION SHEET

This project report entitle Characterization of Intermetallic Growth in Gold Ball Bonds on Aluminum Metallization was prepare and submitted by Lim Moy Fung (Matrix Number: 031010663) and has been found satisfactory in terms of scope, quality and presentation as partial fulfillment of the requirement for the Bachelor of Engineering (Microelectronics Engineering) Universiti Malaysia Perlis (UniMAP).

Checked and Approved by

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(MR. MOHD KHAIRUDDIN MD ARSHAD)
PROJECT SUPERVISOR

School of Microelectronic Engineering
Universiti Malaysia Perlis

March 2007

PENCIRIAN PERTUMBUHAN ANTARA LOGAM DALAM IKATAN BEBOLA EMAS PADA PERMUKAAN ALUMINIUM

ABSTRAK

Projek ini bertujuan untuk menguji-kaji kebolehan proses pelekatan wayar emas dengan menyelidik pertumbuhan antara logam antara pelekatan wayar emas pada tapak permukaan aluminium. Kajian ini dilakukan pada suhu simpanan 150 °C dan 200 °C untuk masa yang berlainan. Hubungan di antara rintangan elektrik dan pertumbuhan antara logam juga dikaji. Penyahkapsulan proses dan Mikroskop Imbasan Electron Pancaran Medan (FESEM) digunakan untuk menentukan liputan antara logam yang lebih tepat. FESEM juga digunakan untuk mendapatkan imej mikrograf bagi pertumbuhan antara logam, lohong Kirkendall dan seterusnya fasa antara logam dengan menggunakan EDX untuk keratan rentas simple. Keputusan analisis menunjukkan rintangan elektrik dan magnitud ketebalan pertumbuhan antara logam berkadar langsung terhadap masa dan suhu terma. Dengan perubahan terma, pelekatan wayar emas menunjukkan pembentukkan lohong Kirkendall dan fasa antara logam yang berbeza dari pertumbuhan antara logam.

ABSTRACT

The objective of this project is to study the capability of gold wire bonding process by investigating the intermetallic growth between gold ball bonds and aluminum bond pad. The study includes applying thermal storage conditions at 150 °C and 200 °C at various intervals time. The relationships between electrical resistance and intermetallic growth were also investigated. Process decapsulation and Field Emission Scanning Electron Microscopy were used to accurately determine the intermetallic coverage of gold ball and aluminum bond pad. Then Field Emission Scanning Electron Microscopy was used to obtain the micrograph image of intermetallic growth, Kirkendall Voiding and followed by intermetallic phase by using EDX for cross sectioned sample. The results indicated that the electrical resistance and magnitude of growth in intermetallic Al-Au is proportional to the amount duration of curing time at aging temperature. Under thermal aging, the gold wire ball bonds show formation of Kirkendall voids and different intermetallic phases apart from intermetallic compound growth.

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LIST OF SYMBOLS, ABBREVIATIONS OR NOMENCLATURE

Ag	silver
Al	Aluminum
Au	Gold
Å	Armstrong
Be	Beryllium
BF	Bright Field
BSE	Backscattered electrons
C	Constant
Ca	Calcium
Cl	Chlorine
Cr	Chromium
Cu	Copper
E	Activation Energy For Layer Growth (In Electron Volts)
e	Exponent
EDS	Energy Dispersive Spectroscopy
F	Fluorine
Fe	Ferum
FESEM	Field Emission Scanning Electron Microscope
HTS	High Temperature Storage Testing
IC	Integrated Circuit
I_D	Drain Current
IMC	Intermetallic Coverage
IP	Intermetallic Phase
k	Diffusion Rate Constant
K	Boltzmann Constant
KOH	Potassium Hydroxide Pellets

Mg	Magnesium
Mn	Manganese
Mo	Molybdenum
Ni	Nickel
O	Oxygen
P	Phosphorus
Pd	Palladium
Pt	Platinum
RDS(on)	Drain To Source On Resistance
SE	Secondary Electron
Si	Silicon
SOIC	Small-Outline integrated Circuit
T	Absolute Temperature (in Kelvins)
t	Aging Time
Ti	Tatinum
T/C	Thermocompression
T/S	Thermosonic
T/U	Ultrasonic
V_{GS}	Gate Threshold Voltage
WDS	Wavelength Dispersive Spectroscopy
x	Intermetallic Thickness (cm)
ρ	Resistivity
α	Alpha
β	Beta
γ	Gamma
μ	Micro
Ω	Ohm