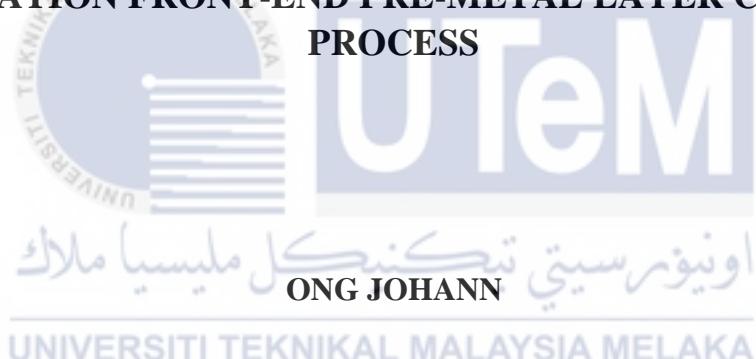




**ELIMINATION OF SALICIDE RESIDUES IN WAFER
FABRICATION FRONT-END PRE-METAL LAYER CLEANING
PROCESS**

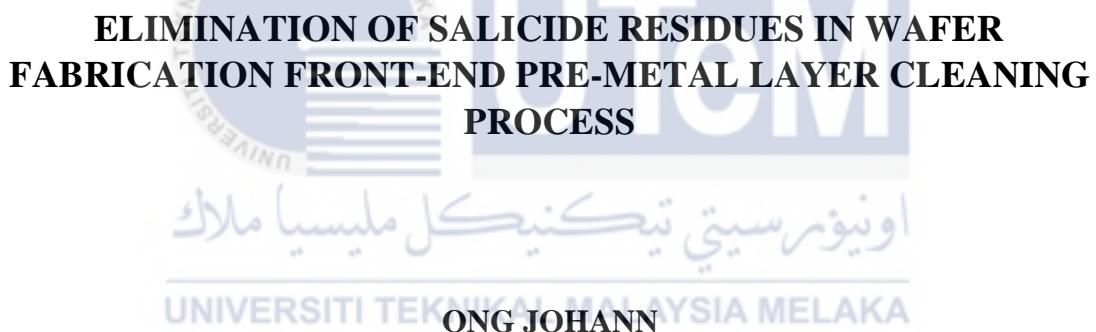


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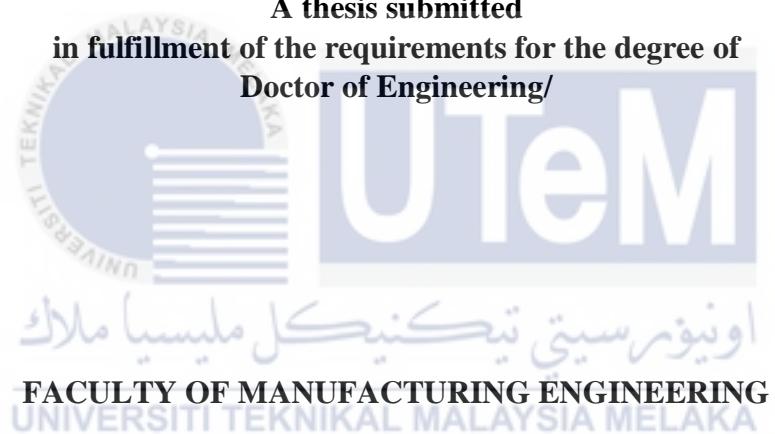


Doctor of Engineering

2022

ELIMINATION OF SALICIDE RESIDUES IN WAFER FABRICATION FRONT-END PRE-METAL LAYER CLEANING PROCESS

ONG JOHANN



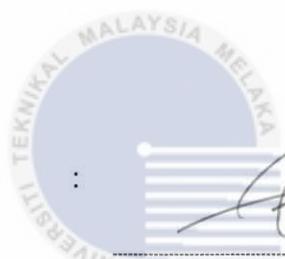
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DECLARATION

I declare that this thesis entitled “Elimination of Salicide Residues in Wafer Fabrication Front-End Pre-Metal Layer Cleaning Process” 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.

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Date

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APPROVAL

I hereby declare that I have read this thesis and in my opinion, this thesis is sufficient in terms of scope and quality for the award of Doctor of Engineering.

Signature : 

Supervisor Name : NOREFFENDY TAMALDIN

Date : 5 OCT 2022



DEDICATION

To my wife, my children and my parents.



ABSTRACT

Wafer fabrication for integrated circuit is one of the most complicated process in semiconductor manufacturing industry. High yield is always the ultimate goal to achieve hence a good defect management is the key to ensure the goal is met. Salicide residue is a major defect in SilTerra wet etching process. The defect is contributing a total of 1% loss in overall wafer fab sort yield, that is an equivalent to USD\$ 5 million loss per year. The objectives for this research is to identify the root cause and determine the element of the residue defect in the wafer substrate at Salicide Pre-Clean wafer fabrication process. Once this has been achieved, next is to determine a novelty solution to reduce the residue defects and finally validate the effectiveness of the novel solution in reducing the salicide residue defects. An investigation of one factor at the time has been conducted with various experiments including screening all the hardware resources available at SilTerra fab by using ANOVA studies. The result has concluded that the salicide residue consists of carbon defect is observed after Salicide Pre-Clean step when the standard diluted hydrofluoric acid (dHF) is used by the wet station equipment to clean the product wafers. This project has discovered an innovated solution to minimize the chemical contact on the wafer has resulted in reducing the post clean defects residue by 80% and eliminate 1% of the total product sort yield loss which is equivalent to approximately USD\$ 5 million per year. The procedure had been qualified and implemented successfully in SilTerra and therefore eliminating the yield loss issue.

جامعة ملaka التقنية

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**PENGHAPUSAN BAHAN SALISIDA DALAM PROSES PEMBERSIHAN LAPISAN
PRA LOGAM PEMBUATAN WAFER HADAPAN**

ABSTRAK

Fabrikasi Wafer untuk litar bersepadu adalah salah satu proses yang paling rumit dalam industri pembuatan semikonduktor. Hasil yang tinggi sentiasa menjadi matlamat utama untuk dicapai oleh itu, pengurusan kecacatan yang baik adalah kunci untuk memastikan matlamat dipenuhi. Sisa salisida adalah kecacatan utama dalam proses punaran basah SilTerra. Kecacatan ini menyumbang sejumlah 1% kerugian dalam keseluruhan isihan hasil fabrikasi wafer, yang bersamaan dengan kerugian kira kira USD \$ 5 juta setahun. Objektif penyelidikan ini adalah untuk mengenal pasti punca-punca dan menentukan unsur kecacatan sisa dalam substratum wafer pada proses pra bersih salisida dalam fabrikasi wafer. Apabila ini telah dicapai, seterusnya adalah untuk menentukan penyelesaian kebaharuan untuk mengurangkan kecacatan sisa dan akhirnya mengesahkan keberkesanan larutan novel dalam mengurangkan kecacatan sisa salisida. Siasatan terhadap satu faktor pada satu masa telah dijalankan dengan pelbagai eksperimen termasuk menyaring semua sumber perkakasan yang terdapat di SilTerra fab dengan menggunakan kajian ANOVA. Hasilnya telah menyimpulkan bahawa residu salisida terdiri daripada kecacatan karbon diperhatikan selepas langkah proses Pra Bersih Salisida apabila asid hidrofluorik dicairkan standard (dHF) digunakan oleh peralatan stesen basah untuk membersihkan wafer produk. Projek ini telah menemui penyelesaian inovatif untuk meminimumkan sentuhan kimia pada wafer telah mengakibatkan pengurangan sisa kecacatan pasca bersih sebanyak 80% dan menghapuskan 1% daripada jumlah kehilangan hasil jenis produk yang bersamaan dengan kira-kira USD\$ 5 juta setahun. Prosedur ini telah layak dan dilaksanakan dengan jayanya di SilTerra dan oleh itu menghapuskan isu kehilangan hasilan wafer produk. Projek ini telah menemui penyelesaian inovatif untuk meminimumkan sentuhan kimia pada wafer telah mengakibatkan pengurangan sisa kecacatan pasca bersih sebanyak 80% dan menghapuskan 1% daripada jumlah kehilangan hasil jenis produk yang bersamaan dengan kira-kira USD\$ 5 juta setahun. Prosedur ini telah layak dan dilaksanakan dengan jayanya di SilTerra dan oleh itu menghapuskan isu kehilangan hasil

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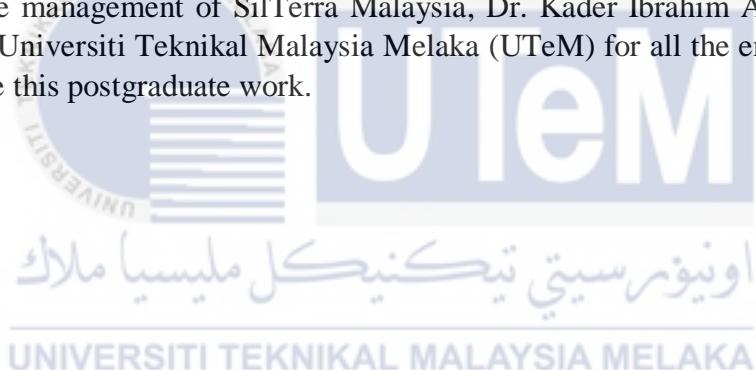


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LIST OF SYMBOLS AND ABBREVIATIONS

5G	-	Fifth generation
Al ₂ O ₃	-	Aluminium Oxide
AMAT	-	Applied Material
Ag	-	Silver
AI	-	Artificial intelligent
AOP	-	Annual Operation Plan
APM	-	Ammonia Peroxide Mixture
Au	-	Gold
BNI	-	Bottleneck Index
BOE	-	Buffer Oxide Etch
BEOL	-	Back End of Line
BKM	-	Best Known Method
BLRS	-	Block Etch Resist Strip
°C	-	Celsius
C	-	Carbon
Ca	-	Calcium
CAGR	-	Compound annual growth rate