

國立交通大學

電子工程學系 電子研究所碩士班

碩士論文

超薄化矽轉移與氧化矽接合在背照式感光元件
上之應用



Ultra-Thin Silicon Layer Transfer with Oxide Bonding for
BSI-CIS Application

研究生：何星漢

指導教授：陳冠能 博士

中華民國一〇一年十月

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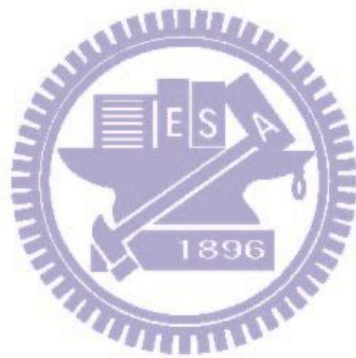
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摘 要

本論文呈現三維積體電路技術之超薄矽晶圓薄膜轉移以應用於背像式互補式金氧半導體影像感測器。此超薄晶圓轉移技術可有效增加感測晶片的畫素以及更高的曝光強度。為了進一步控制各個單一製程參數，首先簡化元件製作並且開發一套可應用於背向互補金氧半導體影像感測器測試之平台。此平台最為關鍵的技術即是晶圓級氧化矽接合以及超薄化矽晶圓轉移。首先，在晶片鍍上同樣厚度的氧化矽，利用不同的二氧化矽組合配上前處理以選定適當的氧化矽材料做為接合層。接著進行晶圓級氧化矽接合，改變接合中的參數，如溫度、接合力道、給予力道方式、前處理方式、氧化矽種類，利用超音波檢測影像可得到合適的晶圓級氧化矽接合參數。另一項矽薄膜轉移製程技術部分，將氫離子植入後並且進行 250 度 30 分鐘二氧化矽接合，

利用 SIMS 觀測氫離子植入位置。接著在退火製程過後將矽轉移到另一塊晶片，使用 FIB/TEM 圖形影像分析轉移後之矽薄膜，發現並沒有缺陷存在，可證明是一良好的轉移方式，並且製程溫度可全程在 400 度下進行。此超薄化晶圓轉移測試平台搭配高品質晶圓級二氧化矽接合，經過檢測證實可應用在背向式金氧半影像感測器元件製作。



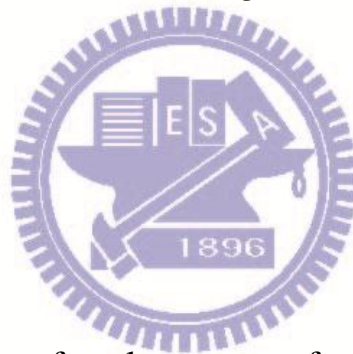
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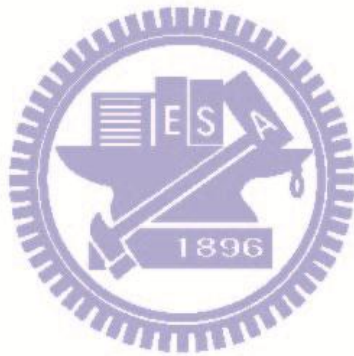


Abstract:

Ultra-thin silicon wafer layer transfer using three-dimension integration circuits (3D-ICs) technologies for the application of backside illumination CMOS image sensor (BSI-CIS) is presented in this thesis. This ultra-thin silicon wafer transfer technology can not only efficiently enhance the pixel number of CMOS image sensor but also achieve higher exposure intensity. In order to further control each process parameter, a simplified test vehicle, which provides the ability to apply to BSI-CIS and component fabrication, was developed. The key technologies of this

simplified test vehicle include wafer-level oxide bonding and ultra-thin silicon wafer layer transfer. For oxide bonding technology, different oxide species with different pre-treatment before bonding was selected to investigate the corresponding chip-level bond quality for the oxide bond material candidate. After the species was determined, wafer-level oxide bonding under different bonding process parameters, such as bonding temperature, bonding pressure, given force type, pre-treatment solution and oxide species, was studied. Finally, with inspection results of scanning acoustic tomography (SAT), a suitable wafer-level oxide bonding parameter can be achieved. Another key technology in the simplified test vehicle is ultra-thin silicon transfer process, H⁺ ions were implanted, followed by the oxide bonding at 250 °C for 30 min. Secondary ion mass spectrometry (SIMS) data was employed to investigate the position of H ions. The ultra-thin silicon layer transfer was accomplished after annealing. The FIB/TEM images show no obvious defects in the transferred Si layer, indicating a good method for silicon layer transfer with whole process temperature below 400 °C. This ultra-thin silicon layer transfer simplified test vehicle using high quality wafer-level oxide bonding is successfully demonstrated and shows the

potential for the fabrication of BSI-CIS application.



致 謝

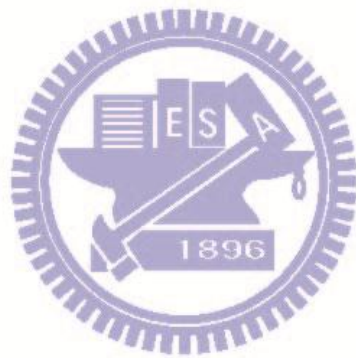
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Contents

Abstract (Chinese)	I
Abstract (English)	III
Acknowledgement	VI
Contents	VIII
Table Captions	X
Figure Captions	XI

Chapter 1 Introduction

1-1 General Background.....	1
1-2 Motivation: Why do we need good oxide bonding quality and ultra-thin Si layer transfer?.....	4
1-3 Organization of the Thesis.....	7

Chapter 2 Experimental Instruments

2-1 Introduction	13
2-2 Process Instruments.....	13
2-3 Material Analysis Instruments.....	18

Chapter 3 3D IC Key Technology - Bonding

3-1 Introduction.....	28
3-2 Oxide bonding Mechanism.....	29
3-3 Experiment Procedure.....	32
3-4 Result and Discussion.....	34
3-5 Summary.....	38

Chapter 4 Ultra-Thin Silicon Layer Transfer

Procedure

4-1 Introduction.....	48
4-2 Mechanism of silicon split.....	48
4-3 Experimental Procedure.....	50
4-4 Results and Discussion.....	51

Chapter 5 Conclusions and Future Work

5-1 Conclusions.....	68
5-2 Future work.....	69

Table Caption

Chapter1 Introduction

Table I-I	Classification of 3D IC processes and integration techniques.....	12
-----------	---	----

Chapter 3 3D IC Key Technology - Bonding

Table III-I	Oxide bonding combine with different dipping time verse oxide species match.....	39
-------------	--	----



Figure Captions

Chapter1 Introduction

Figure 1-1 Intel demonstrates roadmap.....	9
Figure 1-2 3D-IC technology integrate different function chips by heterogeneous stack.....	9
Figure 1-3 3D integration can improve performance compare with nowday 2D circuit.....	10
Figure 1-4 Comparison between SoC, SiP, and 3D-IC.....	10
Figure 1-5 Development of 3D-IC scheme.....	11
Figure 1-6 Comparison between wire bonding and TSV.....	11

Chapter 2 Experimental Instruments

Figure 2-1 Main flow of experimental procedures.....	23
Figure 2-2 Outlook of plasma enhanced chemical vapor deposition.....	23
Figure 2-3 Outlook of flip chip bonder.....	24
Figure 2-4 Outlook of (a) EVG 501 (b) the wafer holder of EVG	

501.....	25
Figure 2-5 Outlook of EVG 501.....	25
Figure 2-6 Outlook of scanning electron microscopy.....	26
Figure 2-7 Outlook of P-10 surface profiler and information panel.....	26
Figure 2-8 Outlook of Transmission Electron Microscope.....	27
Figure 2-9 Outlook of scanning acoustic tomography (SAT).....	27

Chapter 3 3D IC Key Technology – TSV

Figure 3-1 Wafer bow schematic diagram.....	40
Figure 3-2 Oxide bonding mechanism schematic diagram.....	40
Figure 3-3 SAT image of wet oxide to wet oxide bonding under 40N, 250°C and 30min by EVG 501 with H ₂ O ₂ pre-treatment.....	41
Figure 3-4 SAT image of wet oxide to PECVD TEOS bonding under 40N, 250°C and 30min by EVG 501 with H ₂ O ₂ pre-treatment.....	41
Figure 3-5 SAT image of wet oxide to wet oxide bonding under 40N, 250°C and 30min by EVG 520 with H ₂ O ₂	

pre-treatment.....	42
Figure 3-6 SAT image of wet oxide to wet oxide bonding under 40N, 250°C and 30min by EVG 501 with modified clean pre-treatment.....	42
Figure 3-7 SAT image of wet oxide to wet oxide bonding under 40N, 250°C and 30min by EVG 501 with modified clean pre-treatment.....	43
Figure 3-8 SAT image of wet oxide to LPCVD TEOS bonding under 40N, 250°C and 30min by EVG 501 with modified clean pre-treatment.....	43
Figure 3-9 SAT image of wet oxide to LPCVD TEOS bonding under 40N, 400°C and 30min by EVG 501 with modified clean pre-treatment.....	44
Figure 3-10 SAT image of wet oxide to PECVD TEOS bonding under 40N, 250°C and 30min by EVG 501 with modified clean pre-treatment.....	44
Figure 3-11 SAT image of wet oxide to PECVD TEOS bonding under 40N, 400°C and 30min by EVG 501 with modified clean pre-treatment.....	45

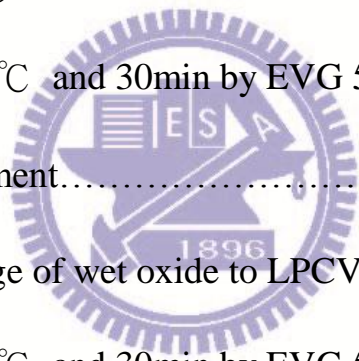
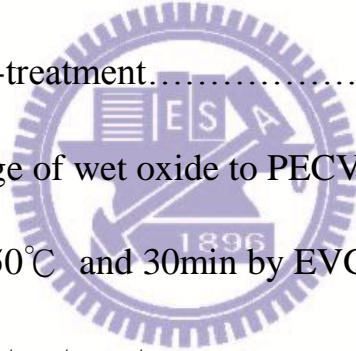


Figure 3-12 SAT image of wet oxide to LPCVD TEOS bonding under 1000N, 250°C and 30min by EVG 520 with modified clean pre-treatment.....	45
Figure 3-13 SAT image of wet oxide to LPCVD TEOS bonding under 10KN, 250°C and 30min by EVG 520 with modified clean pre-treatment.....	46
Figure 3-14 SAT image of wet oxide to PECVD TEOS bonding under 1000N, 250°C and 30min by EVG 520 with modified clean pre-treatment.....	46
Figure 3-15 SAT image of wet oxide to PECVD TEOS bonding under 10KN, 250°C and 30min by EVG 520 with modified clean pre-treatment.....	47



Chapter 4 TSV Process Integration

Figure 4-1 Ideal split off scheme.....	56
Figure 4-2 Blistering occur scheme.....	56
Figure 4-3 Implant depth 370KeV(4μm)/9E16/1H+.....	57
Figure 4-4 Implant depth 120KeV(1μm)/6E16/1H+.....	57
Figure 4-5 SIMS data direction definition.....	58

Figure 4-6	After silicon split after 400 °C anneal.....	58
Figure 4-7	After silicon split after 400 °C anneal.....	59
Figure 4-8	(a) (b) Oxide thickness confirm by SEM.....	59
Figure 4-9	After silicon split surface.....	60
Figure 4-10	Before silicon split cross section overview.....	61
Figure 4-11	Before silicon split layer thickness confirm.....	61
Figure 4-12	Before silicon split oxide bonding interface.....	62
Figure 4-13	Before silicon split (a) silicon defect position (b) silicon defect.....	62
Figure 4-14	(a) (b) Silicon defects before annealing process.....	63
Figure 4-15	Before silicon split (a) defect check position (b) interface between silicon and oxide.....	64
Figure 4-16	After silicon split overview.....	65
Figure 4-17	After silicon split thickness check.....	66
Figure 4-18	After silicon split oxide bonding interface.....	66
Figure 4-19	After silicon split (a) defect check position (b) defect check.....	67