No.1022002

LSI Adding Lapis Miyagi as a new production site for 0.18um memory products as a part of BCP(2)

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March 1, 2022
ROHM Co., Ltd.
Takashi Shimane / General Manager / WP Control Div. WP Production Headquarters

1．Summary of the change

1-1) Purpose:

・To establish multiple manufacturing locations as a part of BCP (Business Continuity Plan) by transferring some production from Rohm Kyoto factory to Lapis Semiconductor Miyagi factory.

1-2) Contents:

・Add Lapis Miyagi factory as a second fab for 0.18um memory products.
Lapis Miyagi factory has produced products using the same line as that of Rohm Kyoto since 2013.
Quality and characteristics are guaranteed.
(The change is only for the frond end process and there will be no changes to the assembly site)

1-3) Schedule of change:

・Upon customer approval.
Once production is transferred, all production will be done at the new site only.

2. Lapis Miyagi factory overview

2-1) Lapis Miyagi

Company name ： Lapis Semiconductor Co., Ltd.
Location ： 1, Okinodaira Ohira-mura Kurokawa-gun, Miyagi
Establishment ： April 8, 1988
Representative ： Kazumasa Wakuno (President)
Production Item ： Monolithic IC（LSI）
Employee ： 257 (As of Dec,2021)

2-2) LSI production history of Rohm products

Start of production ： Dec,2013
Production Volume ： 96,000 wafers
(As of Dec,2021)
Smallest Design Rule : 0.13um

2. Lapis Miyagi factory overview

2-3) Environmental management (clean room)

Item		Frequency	Method	Unit	Management value	Rohm Kyoto factory (Existing)	Lapis Miyagi factory (New)
Temperature		Continuous Monitoring	Thermometer	℃	23±1	22～24	22～24
Humidity		Continuous Monitoring	Hygrometer	%	45±10	40～50	40～50
Cleanliness	Passage area	Continuous monitoring	Measure by laser dust counter	pcs/cf	35 (0.1um)	Less than 10	Less than 10
	Operation area	Continuous monitoring		pcs/cf	35 (0.1um)	Less than 10	Less than 10
	MASK area	Continuous monitoring		pcs/cf	35 (0.1um)	Less than 10	Less than 10
Smallest design rule (um)						0.13	0.13

In terms of environmental management (clean room), two factories are the same.

3. 5M gap analysis

5M		Rohm Kyoto factory	Lapis Miyagi factory	Comparison
Man	-	The operator will obtain an internal license and will operate according to the operation standard.		Equal
Machine	Equipment in use	No difference (same method)		Equal
	Factory management contents	Conforming to QC chart.		Equal
	Management method	In accordance with facilities QC chart, carrying out SPC management.		Equal
	Transport between equipments	Cart / Robot cart	OHV(Overhead Hoist Vehicle)	Different ※1
Materials	Wafer	200mm Si wafers		Equal
	Others	Same materials is used by centralized supply system.		Equal
Method	Processing condition	Conforming to QC chart.		Equal
	Treatment of the control limits out	Conforming to quality abnormality measures rule.		Equal
	Inspection contents	Conforming to inspection standard.		Equal
Measurement	Measuring equipment ※2	Although there is difference in the equipment depending on the wafer diameter, equipment is calibrated in equal standard such as precision and repeatability .		Equal
	Management method	Conforming to the measurement control spec		Equal

※1 About the Transport between equipments, Rohm Kyoto line uses a cart or automatic robot cart but LAPIS Miyagi line uses OHV(Overhead Hoist Vehicle).

And the wafer storing container is changed to FOUP (Front Opening Unified Pod) from BOX type.

The tolerance for the floating dust greatly improves.

※2 The measuring equipment refers to the equipment of the film thickness, Electric characteristic, Dimensions, Resistivity, Reflectance, Refractive index and Particle.

4. 5M gap analysis (process)

5-1) Target process

Process		Existing	New
Wafer process	STI Gate Metallization Passivation	**Rohm Kyoto factory**	**Lapis Miyagi factory**
Assembly process	Wafer probe test Dicing Assy	No change	
Test process	Final test	No change	

The change is in the wafer process site only.

Assembly and Test location will not change.

4. 5M gap analysis (process)

5-2) Process capability comparison

Process capability of Rohm Kyoto factory was compared with Lapis Miyagi factory, on major processes primary characteristics. Cpk was higher than 1.66.

	Rohm Kyoto factory			Lapis Miyagi factory		
Item	σ	Cp	Cpk	σ	Cp	Cpk
Gate oxide thickness	2.53	2.63	2.14	3.23	2.06	1.81
Gate poly size	0.006	1.73	1.68	0.005	2.14	1.93
CONT size	0.004	2.21	2.03	0.003	2.50	2.14
1st Metal size	0.004	2.02	1.77	0.004	2.20	2.18

n=20Lot each
25point/Lot

4. 5M gap analysis (process)

5-3) Process capability of main element properties

Process capability of Rohm Kyoto factory was compared with Lapis Miyagi factory on main characteristics. Cpk was higher than 1.66.

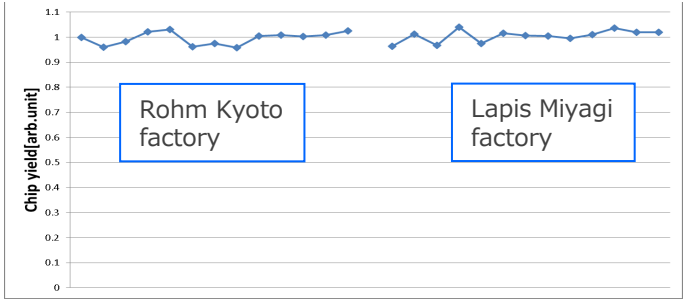
	Rohm Kyoto factory			Lapis Miyagi factory		
Item	σ	Cp	Cpk	σ	Cp	Cpk
NMOS Vth	0.02	1.86	1.81	0.02	1.82	1.74
PMOS Vth	0.02	1.86	1.79	0.02	1.96	1.72
Memory 1Vth	0.27	2.08	2.01	0.27	2.03	1.92
Memory 0Vth	0.27	1.82	1.79	0.22	2.25	2.25
CONT CR	0.60	2.22	2.11	0.33	4.02	3.78
VIA CR	0.40	2.07	2.04	0.44	1.88	1.86

n=20Lot each
25point/Lot

4. 5M gap analysis (process)

5-4) Chip yield(WA measurement)

We compared the Chip yield of Rohm Kyoto factory product with Lapis Miyagi factory product.
There is no difference in CHIP yield of both lines on a monthly basis for the most recent year.



5-5) Wafer level reliability evaluation result

Wafer level reliability evaluation was performed.
All tests satisfy a criterion and do not have any problem.

Test item	Test symbol	Evaluation criteria				Results judgment
		Judgment	Temperature	Voltage/Current	Life	
Gate oxide film	TDDB	0.1%defective rate	150℃	Vccmax:5.5V	20years	Pass
Slow trap	NBTI	ΔIdsat≧10%	150℃	Vccmax:5.5V	20years	Pass
Hot carrier	HCI	ΔIdsat≧10%	Room temperature	Vccmax:5.5V	20years	Pass
Stress migration	SM	ΔR≧10%	150℃	-	20years	Pass
Electro migration	EM	ΔR≧10%	150℃	I=1mA/um	20years	Pass

5. 5M gap analysis (product)

6-1) QAT(Quality Approval Test) result

We show the result of the QAT that were executed on the other product at Lapis Miyagi line, as follows.
All test results satisfy a criterion and do not have any problem.

Test item	Test symbol	The number of samples	Evaluation criteria	Test condition	Test time /cycles	Results judgment
Pressure cooker test	PCT	77pcs×3	Need to clear the spec of specifications and standard of shipment by the FT measurement after the test.	121℃/100%RH 2atm	500h	Pass
Temperature cycle test	TCY	77pcs×3		-65℃ ⇔ 150℃	1000cyc	Pass
High temperature storage test	HST	77pcs×3		150℃	2000h	Pass
High acceleration stress test	HAST	77pcs×3		VDD/130℃ 85%RH	200h	Pass
Dynamic burn in test	B/IN	77pcs×3		VDD/150℃	2000h	Pass
ESD test (Human body model)	HBM	3pcs	Over 2000V	100pF/1.5kohm	-	Pass
ESD test (Machine model)	MM	3pcs	Over 200V	200pF/0ohm	-	Pass

6. Summary

From the 5M gap analysis, Rohm concludes that the 0.18um memory product will have the same level of quality and characteristics with the addition of Lapis Miyagi factory to the existing Rohm Kyoto Fab for front-end fab process.

For the affected products, Rohm will make the change as soon as receiving approval from your company.

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Takashi Shimane
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Reliability evaluation result

Target line:0.18um memory line(BR0.18)

1.Reliability evaluation result of the wafer level
We show the reliability evaluation result of the wafer level at 0.18um memory line as follows.
All tests satisfy a criterion and do not have any problem.

Test item	Test symbol	Evaluation criteria				Results judgment
		Judgment	Temperature	Voltage/Current	Life	
Gate oxide film	TDDB	0.1%defective rate	150℃	Vccmax:5.5V	20years	Pass
Slow trap	NBTI	ΔIdsat≧10%	150℃	Vccmax:5.5V	20years	Pass
Hot carrier	HCI	ΔIdsat≧10%	Room temperature	Vccmax:5.5V	20years	Pass
Stress migration	SM	ΔR≧10%	150℃	-	20years	Pass
Electro migration	EM	ΔR≧10%	150℃	I=1mA/um	20years	Pass

2.QAT(Quality Approval Test) result
We show the result of the QAT that were executed on the other product at LAPIS Miyagi line, as follows.
All test results satisfy a criterion and do not have any problem.

Test item	Test symbol	The number of samples	Evaluation criteria	Test condition	Test time /cycles	Results judgment
Pressure cooker test	PCT	77pcs×3	Need to clear the spec of specifications and standard of shipment by the FT measurement after the test.	121℃/100%RH 2atm	500h	Pass
Temperature cycle test	TCY	77pcs×3		-65℃ ⇔ 150℃	1000cyc	Pass
High temperature storage test	HST	77pcs×3		150℃	2000h	Pass
High acceleration stress test	HAST	77pcs×3		VDD/130℃ 85%RH	200h	Pass
Dynamic burn in test	B/IN	77pcs×3		VDD/150℃	2000h	Pass
ESD test (Human body model)	HBM	3pcs	Over 2000V	100pF/1.5kohm	-	Pass
ESD test (Machine model)	MM	3pcs	Over 200V	200pF/0ohm	-	Pass