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A 300mm test wafer to evaluate charging damage

Fumio Otoi, Yuji Furumura

**Philtech Inc. Shuwa Kioicho TBR Bldg.401,
5-7 Kojimachi Chiyoda-Ku,Tokyo Japan**

Contact to contact@philtech.co.jp

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Philtech Inc. Introduction

Established on	May 21, 2001
Funded by	Yuji Furumura
Capital	JP Yen 205,300,000

Philtech, Inc. produces test wafers which enable to create advanced market for semiconductor development.

Products: 200mm,300mm Blanket,Patterned wafers

***Philtech-unique products:**

Charge-up monitor TEG 300mm

100nm-featured electrical TEG

Standard fine CMP TEG:phil854

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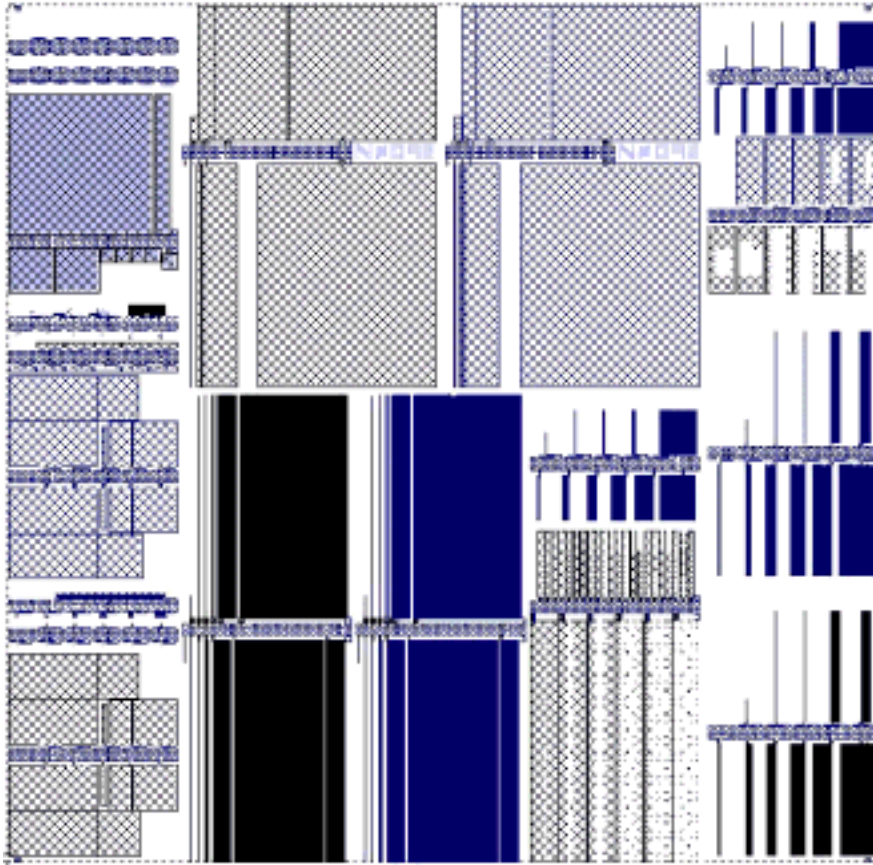
Philtech Charge-up Monitor TEG-1

1. **Wafer Diameter:** 200mm, and 300mm
2. **TEG Constitution:** Antenna MOS Capacitor
3. **Application:**

	<u>200mm Wafer</u>	<u>300mm Wafer</u>
• Gate Antenna:	Available	Available
• Metal Antenna :	Available	Available on request
• Contact Antenna:	Available	Available on request
4. **Features:**

• Practical pattern	Designed by well-experienced Engineer
• Reliable quality	Fabrication in Super Clean-room
• Process condition	Process option(Tox etc.,) available

TEG-Pattern-1: TEG Top View

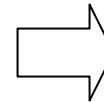
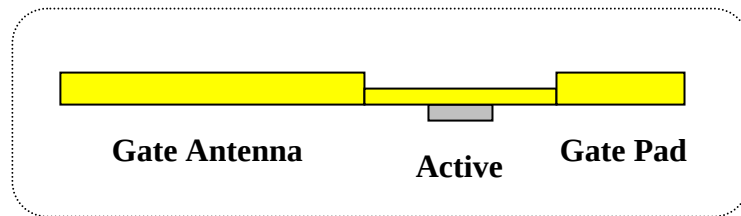


General_Cap	G_BOX_Cap	M_BOX_Cap	
	G_Comb_Cap	M_Comb_Cap	CONT_Cap

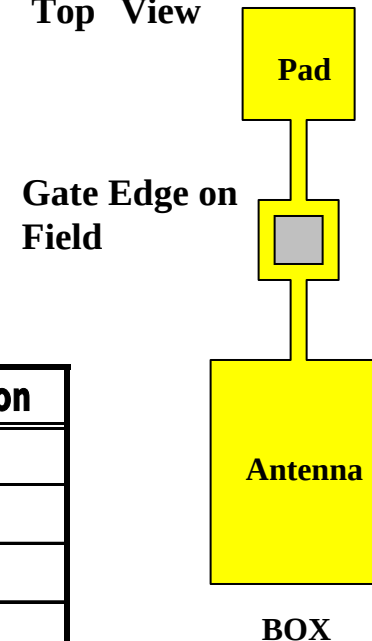
G_BOX_Cap: Gate BOX-Antenna MOS Capacitor

G_Comb_Cap: Gate Comb-Antenna MOS Capacitor

TEG-Pattern-2: Gate BOX-Antenna MOS Capacitor



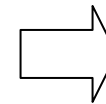
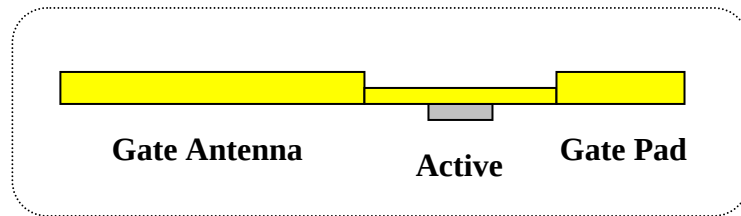
Top View



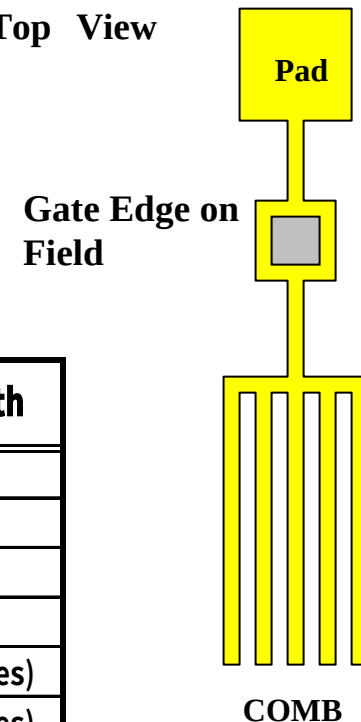
Antenna Ratio = (Antenna Area) / (Active Area)

Antenna Ratio	Active Dimension	Antenna Dimension
2	0.01mm ²	0.02mm ²
10		0.10mm ²
100		1mm ²
500		5mm ²
1K		10mm ²
2K		20mm ²
2.5K	4um ²	0.01mm ² (PAD)
10K		0.04mm ²
100K		0.4mm ²
1M		4mm ²

TEG-Pattern-2: Gate Comb-Antenna MOS Capacitor



Top View



$$\text{Antenna Ratio} = (\text{Thickness} \times \text{Peripheral Length}) / (\text{Active Area})$$

Antenna Ratio (Electrode film thickness:2000 Å)	Active Dimension	Antenna Peripheral Length
0.02	0.01mm ²	1mm (0.5mm×2×1Line)
0.2		10mm (5mm×2×1Line)
2		100mm (5mm×2×10Lines)
20		1000mm (5mm×2×100Lines)
200		10000mm (5mm×2×1000Lines)
1.2K		60000mm (5mm×2×6000Lines)
50	4μm ²	1mm (0.5mm×2×1Line)
500		10mm (5mm×2×1Line)
5K		100mm (5mm×2×10Lines)
50K		1000mm (5mm×2×100Lines)
500K		10000mm (5mm×2×1000Lines)
2.5M		50000mm (5mm×2×5000Lines)

300mm-Wafer Shot Layout

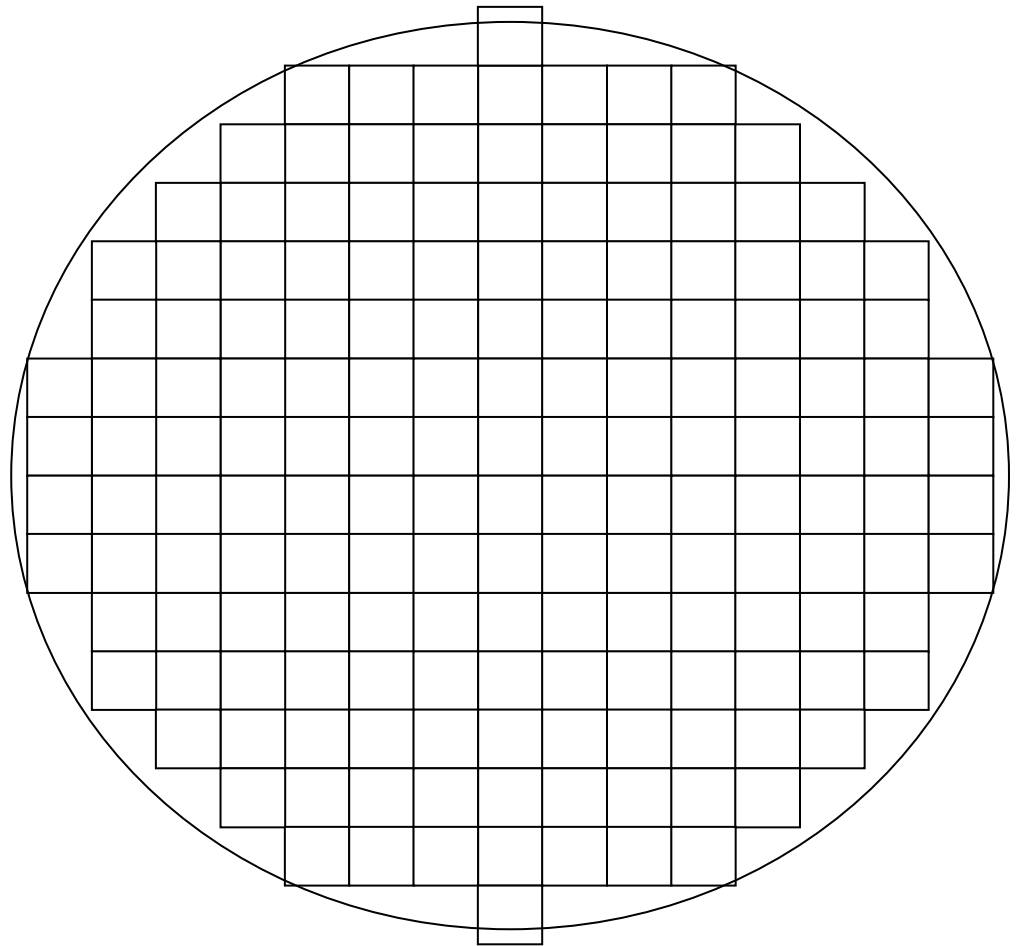
Number of Chips

168

Chip Size

X:19.6mm

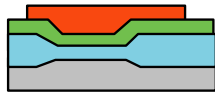
Y:19.4mm



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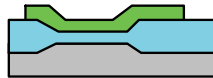
Philtech Charge-up Monitor TEG-2

Providing TEG Structure



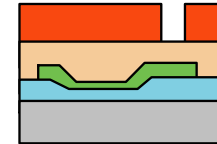
TEG for: Gate etching,
Ashing

After Gate Photo.



CVD,PVD,Ion-
Impla, Cleaning

After Gate Etch.



Contact etching, Ashing
(Available on request)

After Contact Photo.

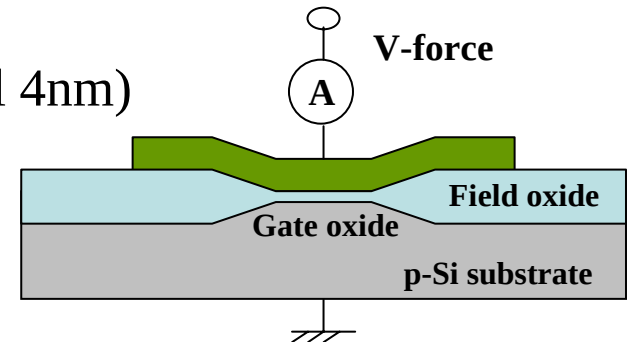
Dielectric
Resist
Poly-Si
Oxide

*Gate Oxide Thickness Option Available (usual 4nm)

Measurement Service

- I-V Characteristics on Antenna Ratio
- Breakdown-Voltage Map Across the Wafer

*Measurement Option (Condition, point etc.), Consulting Available



V-force I-measure

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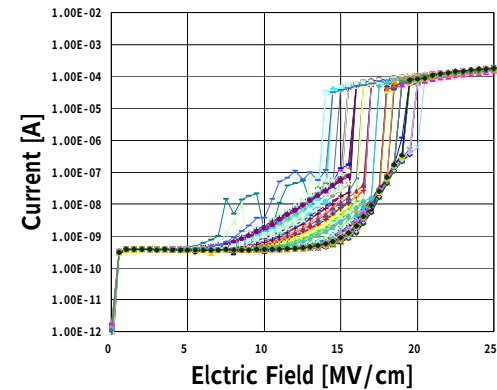
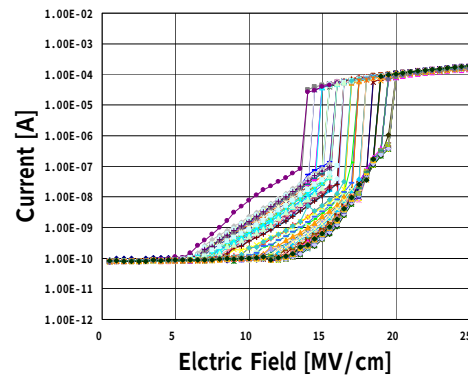
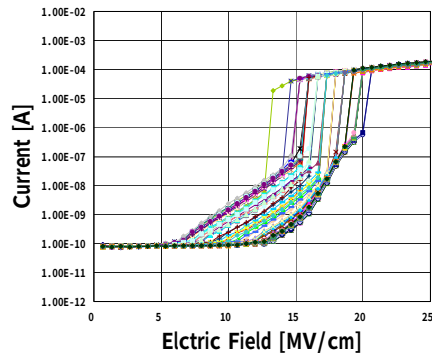
300mm Wafer 1st-Trial Lot Results-1

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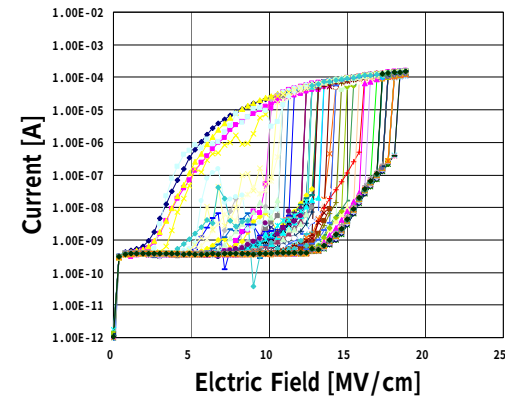
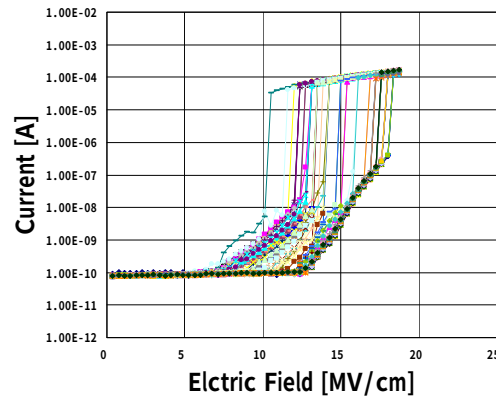
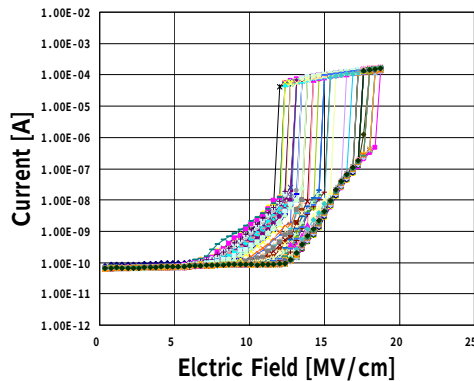
Bulk Wafer , Poly Etcher:A

I-V Characteristics

Gate Oxide 3nm



Gate Oxide 4nm



Antenna Ratio: 10K

100K

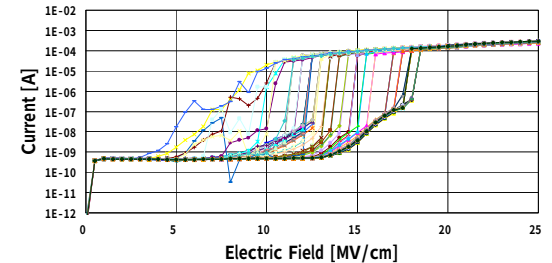
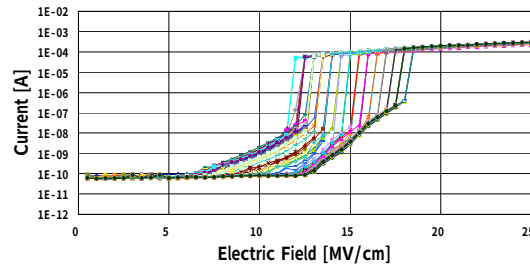
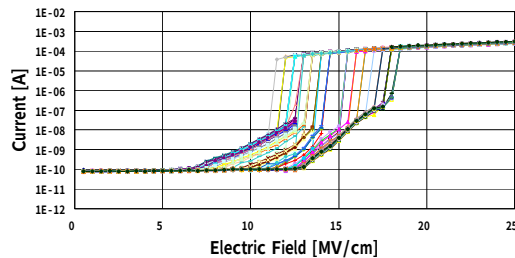
1M

300mm Wafer 1st-Trial Lot Results-2

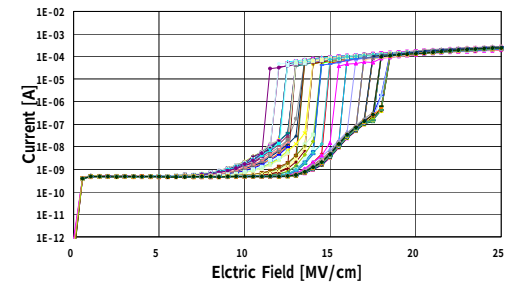
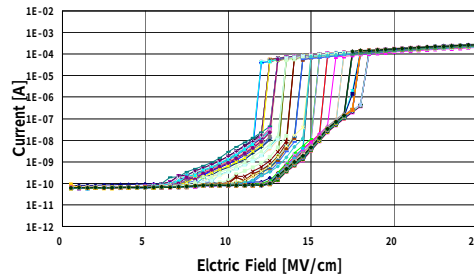
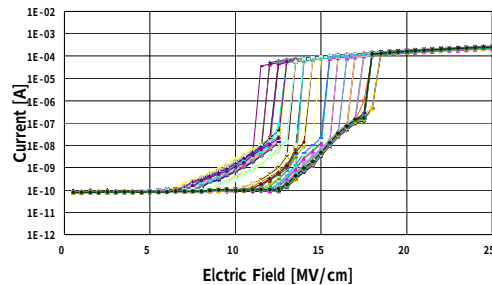
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Gate Oxide 4nm I-V Characteristics

Bulk Wafer , Poly Etcher:A



Bulk Wafer , Poly Etcher:B



Antenna Ratio: 10K

100K

1M

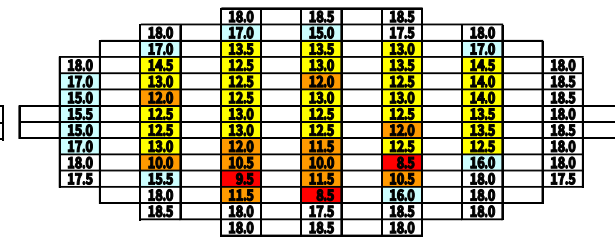
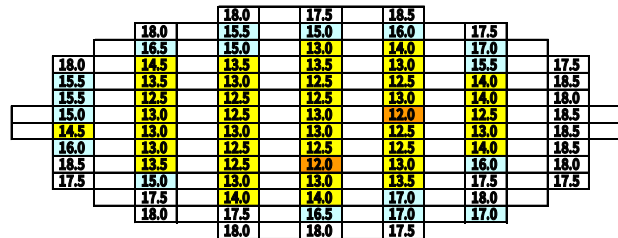
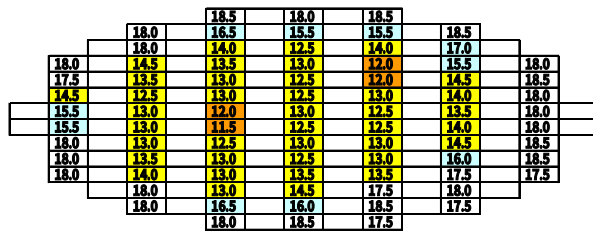
300mm Wafer 1st-Trial Lot Results-2

Philtech Inc.

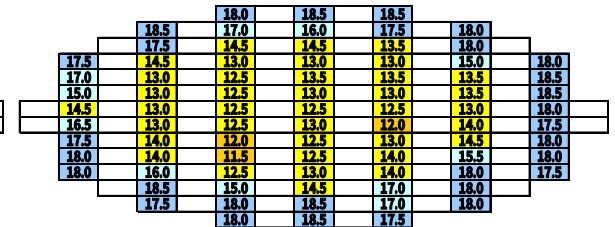
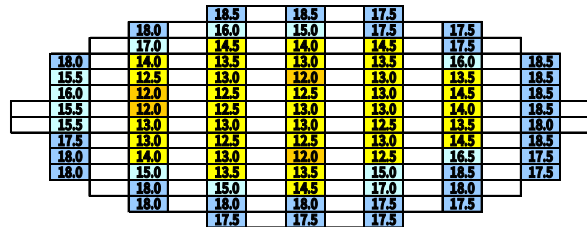
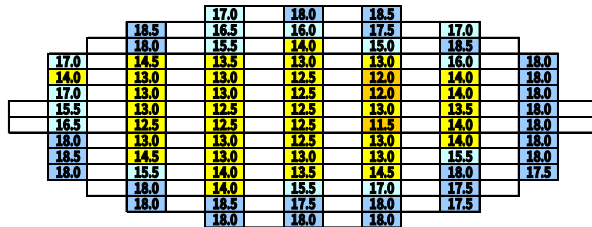
Gate Oxide 4nm Breakdown-Voltage Map(1E-6A)

Bulk Wafer , Poly Etcher:A

RANK	[MV/cm]
~7.5	0.0 ~ 10.0
10.0	10.0 ~ 12.5
12.5	12.5 ~ 15.0
15.0	15.0 ~ 17.5
17.5~	17.5 ~



Bulk Wafer , Poly Etcher:B



Antenna Ratio: 10K

100K

1M

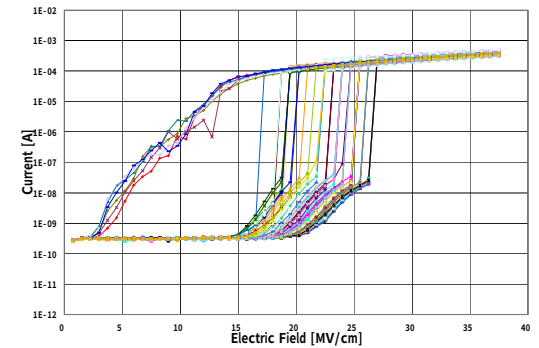
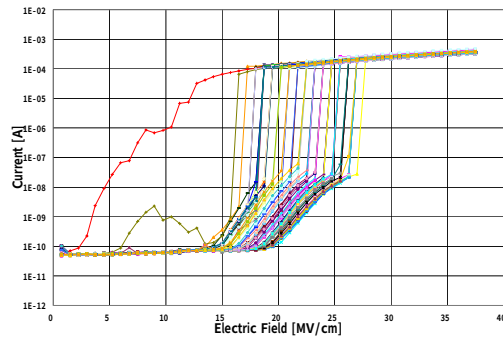
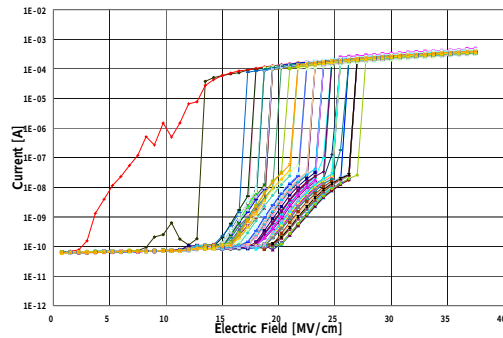
300mm Wafer 2nd-Trial Lot Results

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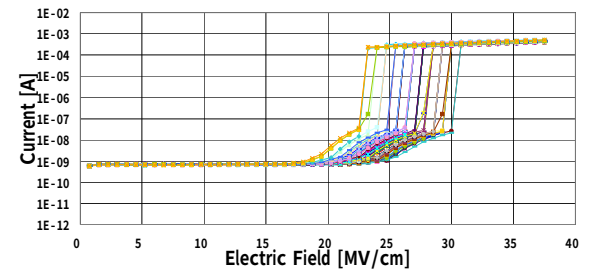
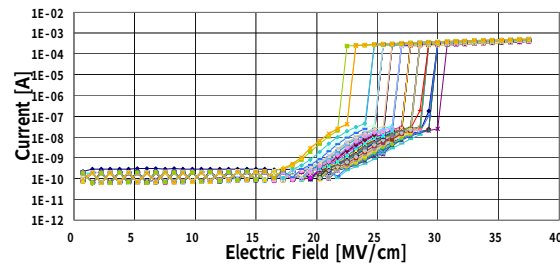
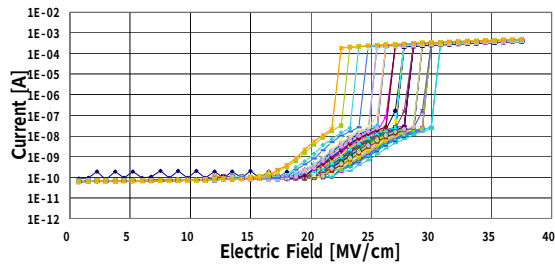
Gate Oxide 4nm

I-V Characteristics

Bulk Wafer , Poly Etcher:A



Epi Wafer , Poly Etcher:B



Antenna Ratio: 10K

100K

1M

300mm Wafer 2nd-Trial Lot Results

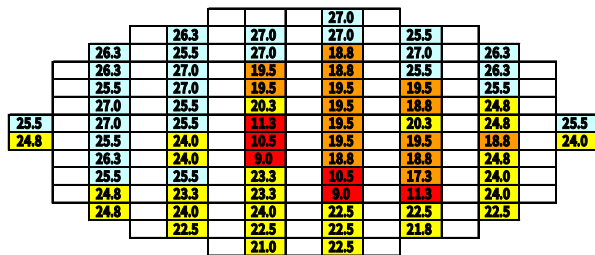
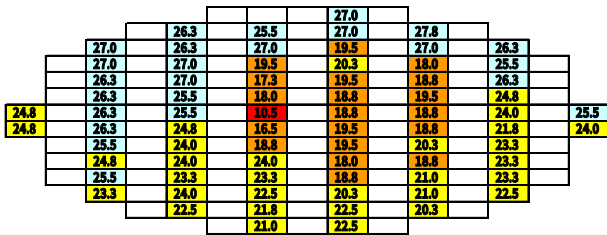
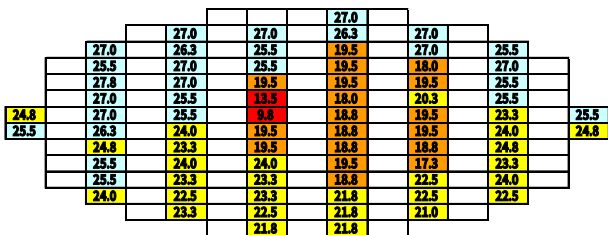
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Gate Oxide 4nm

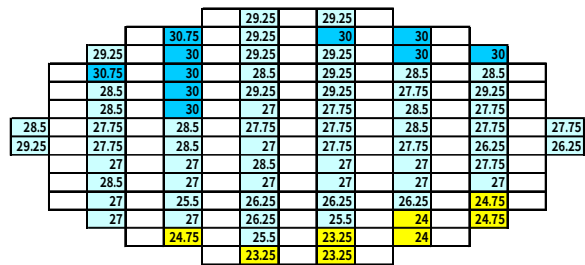
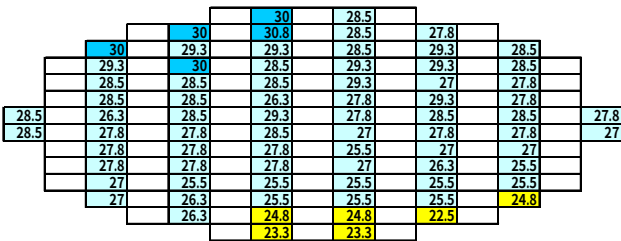
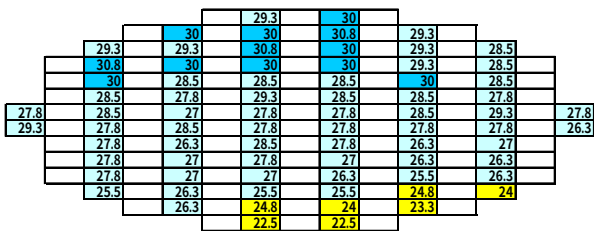
Breakdown-Voltage Map(1E-6A)

Bulk Wafer , Poly Etcher:A

RANK	[MV/cm]
~12.5	~ 14.9
17.5	15.0 ~ 19.9
22.5	20.0 ~ 24.9
27.5	25.0 ~ 29.9
32.5~	30.0 ~



Epi Wafer , Poly Etcher:B



Antenna Ratio: 10K

100K

1M

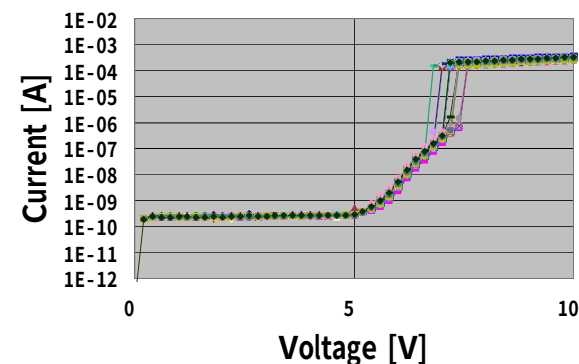
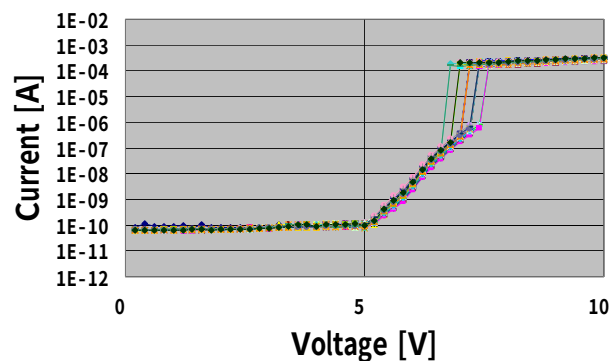
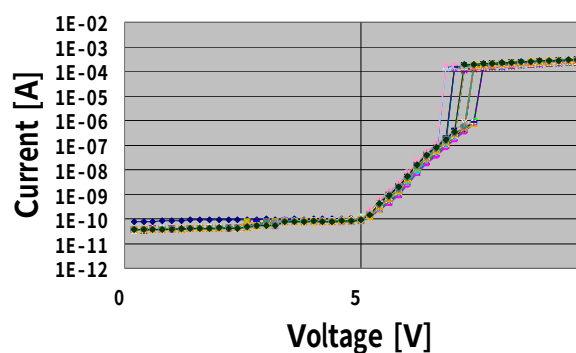
300mm Wafer 3rd-Trial Lot Results

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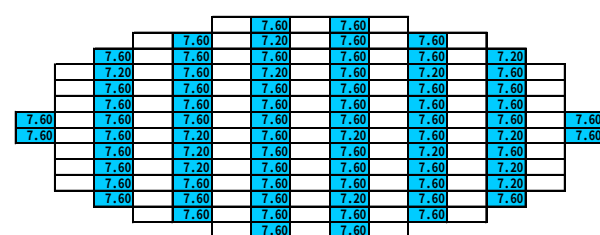
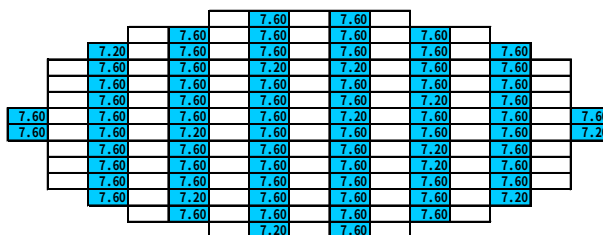
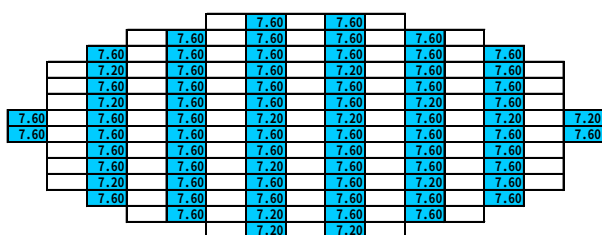
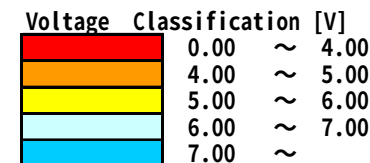
Gate Oxide 4nm

I-V Characteristics

Epi Wafer , Poly Etcher:C



Breakdown-Voltage Map(1E-6A)



Antenna Ratio: 10K

100K

1M

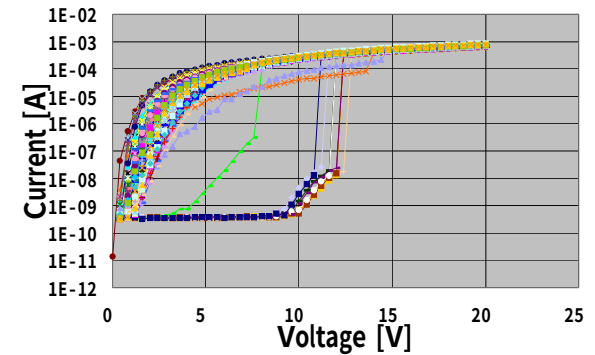
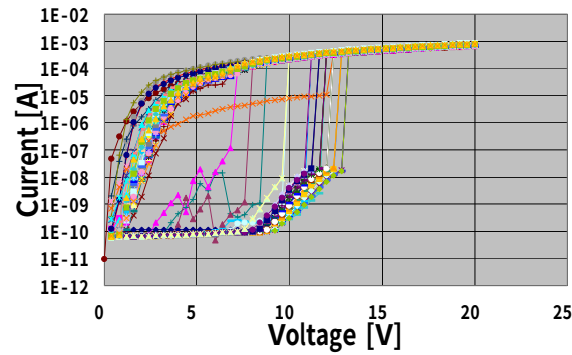
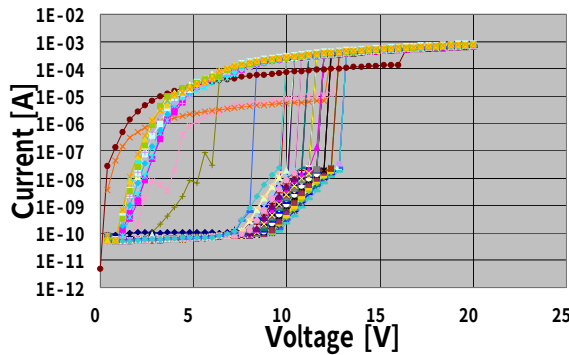
300mm Application Example-1: PE-CVD

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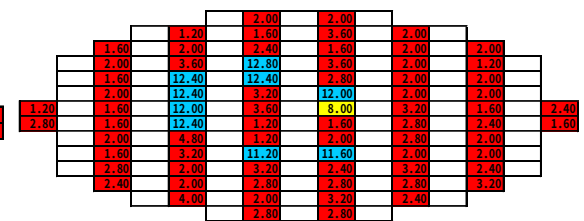
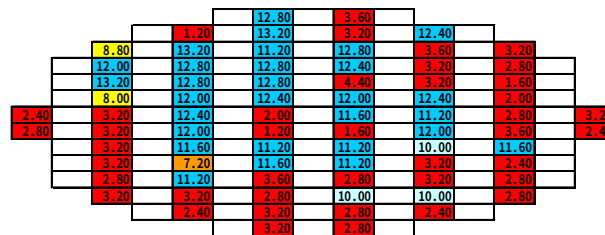
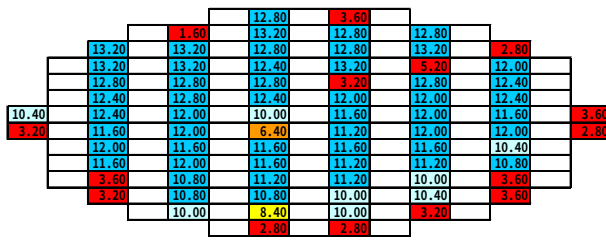
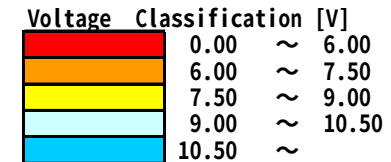
Gate Oxide 4nm

I-V Characteristics

Epi Wafer , Poly Etcher:B



Breakdown-Voltage Map(1E-6A)



Antenna Ratio: 10K

100K

1M

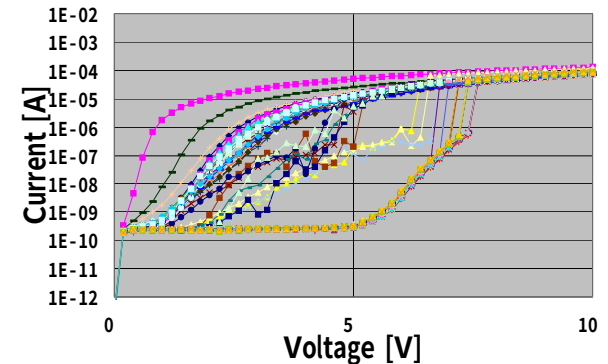
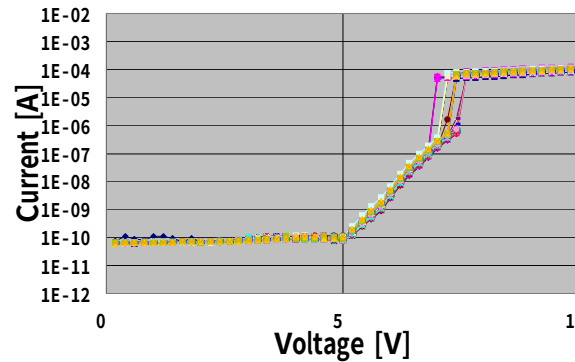
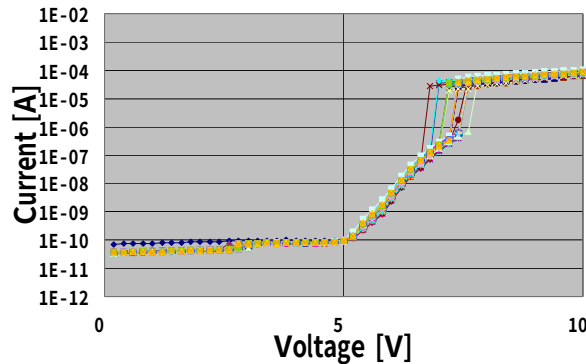
300mm Application Example-2: Ion-Implant

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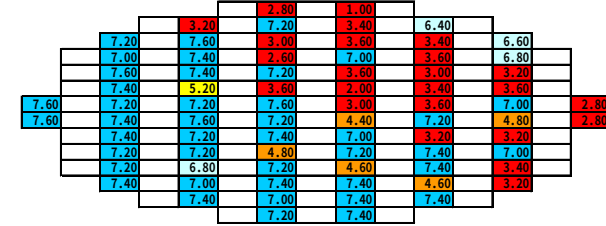
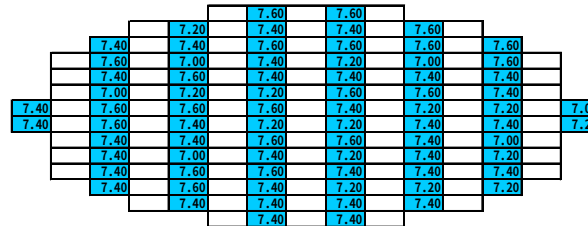
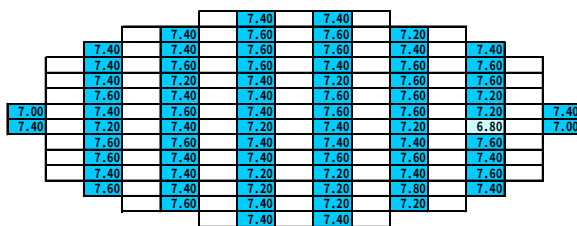
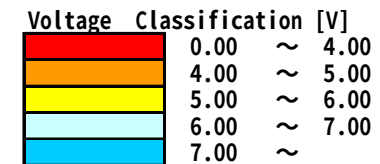
Gate Oxide 4nm

I-V Characteristics

Epi Wafer , Poly Etcher:C



Breakdown-Voltage Map(1E-6A)



Antenna Ratio: 10K

100K

1M

Philtech charge-up monitor T E G Service

Providing Test Wafers

- Wafer structures available on processes
- Delivery: ~3weeks

Measurement Service

- I-V Characteristics on Antenna Ratio
- Breakdown-Voltage Map Across the Wafer
 - *Measurement option Available(Condition, point etc.,)
- Delivery: ~1week(after wafer returned)

Cost(Included measurement service)

- Cost depends on wafer structures.
Please contact to Philtech

Summary

- Philtech has developed 300mm Charge-up Monitor TEG.
- 1st, and 2nd Trial Lot results indicate the split I-V Characteristics within wafer. These come from Bulk-Wafer crystal defect, or no-fitting Etching Process.
- 3rd Trial Lot results indicate the no-split(improved) I-V Characteristics by optimizing Etching process. (Etcher-C)
- Philtech test wafers are provided to evaluate some processes Etching, PE-CVD, Ion-Implant, Etc., Those data prove Philtech wafers are effective on damage evaluation.

Philtech test wafers are very helpful to develop equipments and processes for 300mm wafers.