NARLabs
National Applied Research Laboratories

高精準性元素控制薄膜沈積系統

技術資料

www.narlabs.org.tw

Fiji G2

Plasma Enhanced Atomic Layer Deposition System

ALD Process Window

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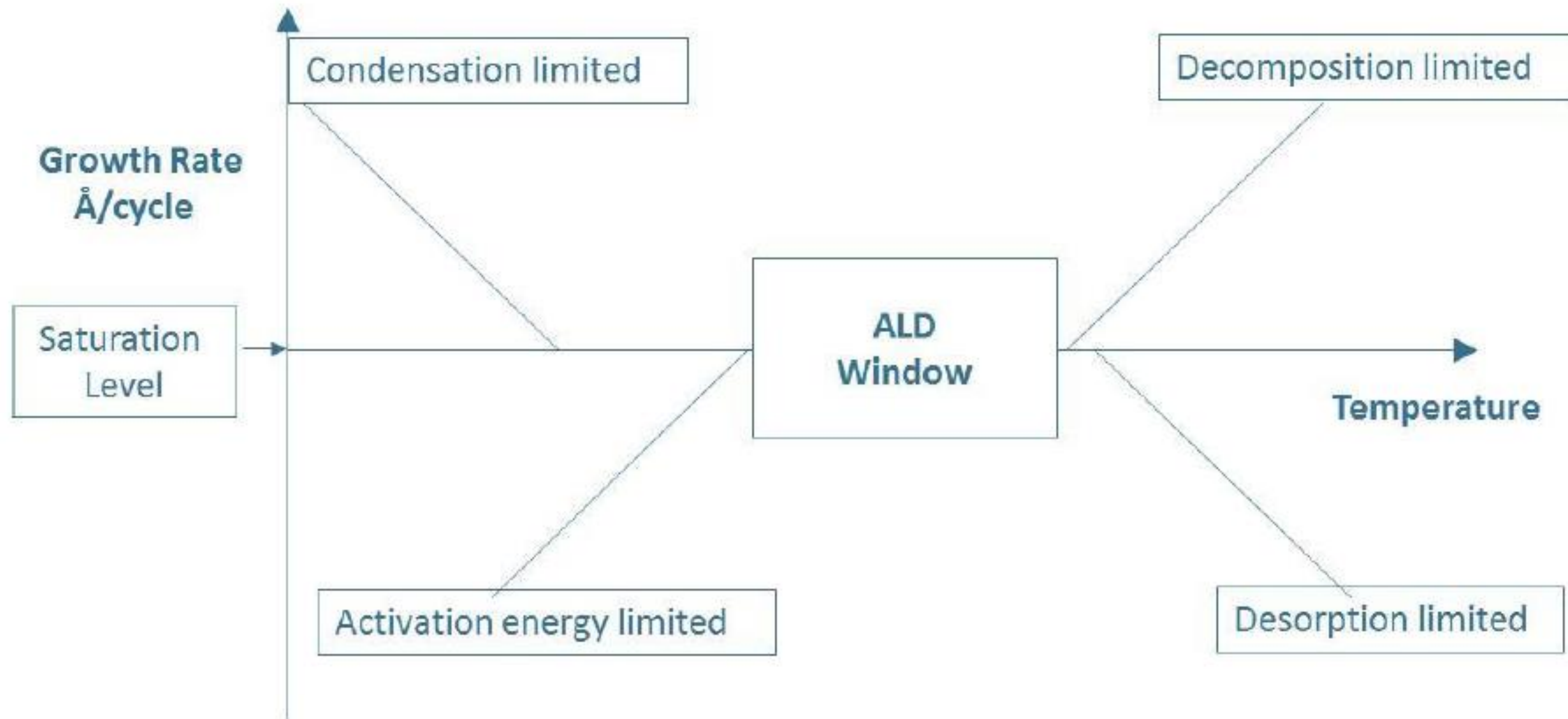

Main Software Screen

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Program Name and Software Revision

Menu Items

System Status Bar

Recipe Information

Precursor Information

Fiji v2015.0.0

File Configuration Communication Security Help

System Status

IDLE

A tool configuration parameter is updated in the config.ini file

User: 'default'

User

Heaters Button

Recipe

Pump Reactor and Load Lock

Vent Reactor and Load Lock

LL Transfer

Heaters: Turn Off

Recipe: Start Recipe, Skip Step

Pump: Pump Reactor, Pump Load Lock

Vent: Vent System, Vent Load Lock

Transfer: Open Gate, Initialize Loader, Load Sample, Unload Sample

Recipe | Heaters

	Instruction	Chan	Value	Units
14	mfc valve	3	1	open
15	turbo purge		0	close
16	turbo gate		0	close
17	turbo iso		0	close
18	reactor rough		1	open
19	gate purge		1	open
20	wait		3	sec
21	pulse	2	0.25	sec
22	wait		4	sec
23	gate purge		0	close
24	reactor rough		0	close
25	turbo iso		1	open
26	turbo gate		1	open
27	turbo purge		1	open
28	flow	3	20	sccm
29	wait		3	sec
30	plasma		300	watts
31	wait		6	sec
32	plasma		0	watts

Recipe

Name: Run 07 HfO2 250C - Plasma.txt

Status: Successfully Completed

Start Time: 09/03 09:30:59

Est. Finish Time: 09/03 14:42:38

Est. Time Remaining: 05:11:39

Cycle 1 of 300

Line 35

Reactor Vent Valve

Plasma Purge Valve

Transfer Gate Purge Valve

Boost-A, Port-1

Bubble-B, Port-5

Delivery Line 16 150 150 °C

Valve Manifold 17 150 150 °C

Precursor

Port	Precursor	Value	Heater	Setpoint	Actual	Units
Port-0	TMA	0.000	23	0	NC	°C
Port-1	MoO3	0.000	18	0	30	°C
Port-2	TDMAHf	0.2500	19	75	75	°C
Port-3	TDMATi	0.000	20	0	33	°C
Port-4	H2O	0.000	21	0	NC	°C
Port-5	Mn(EtCp)2	0.000	22	0	40	°C

sec

MFC	Gas	Setpoint	Actual
MFC-0	CARRIER (Ar)	10	10
MFC-1	PLASMA (Ar)	20	19
MFC-2	NITROGEN	0	0
MFC-3	OXYGEN	0	0
MFC-4	HYDROGEN	0	0
MFC-5	OZONE	0	4

sccm

Mass Flow Controller Information

Plasma Source Controller/ Indicator

Ozone Generator Controller/ Indicator

Fiji Hardware Controllers/ Indicators

Plasma: 0 Watts; 0 Front, 0 Back

Ozone: OFF

13 °C 250 250

Closed

Load Lock: Lid Closed

30 °C 150 150

15 250 250 °C Chuck

14 250 250 °C

24 150 150 °C

Opened

Turbo 59940 rpm

Turbo 60030 rpm

1.42E-3 Chamber

Rough, Soft, Vent, Purge, Turbo Iso

25 °C 105 104

Pressure Plots

Process (Torr) 0.0542

Chamber (Torr) 1.46E-3

Load Lock (Torr) 5.25E-7

LVPD (psig) 16.1

Plot Time: 1 Minute

Pressure: 0.00, 0.0100, 0.0200, 0.0300, 0.0400, 0.0500, 0.0600

Elapsed Time: 17:16:13, 17:16:20, 17:16:30, 17:16:40, 17:16:50, 17:17:00, 17:17:13

ALD Process Flow

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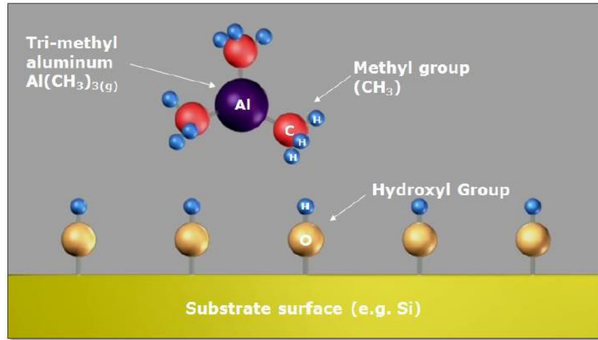
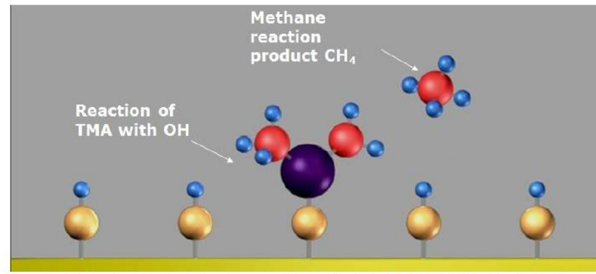
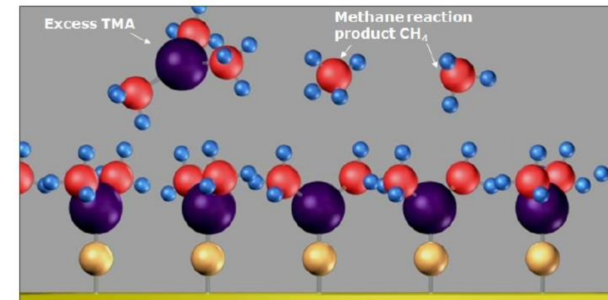
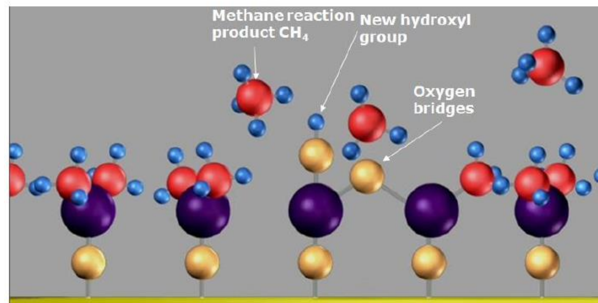
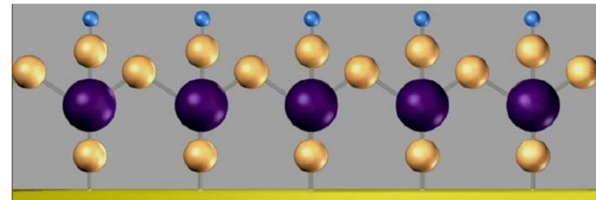
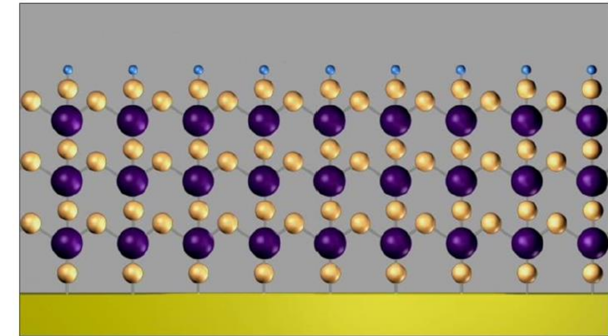










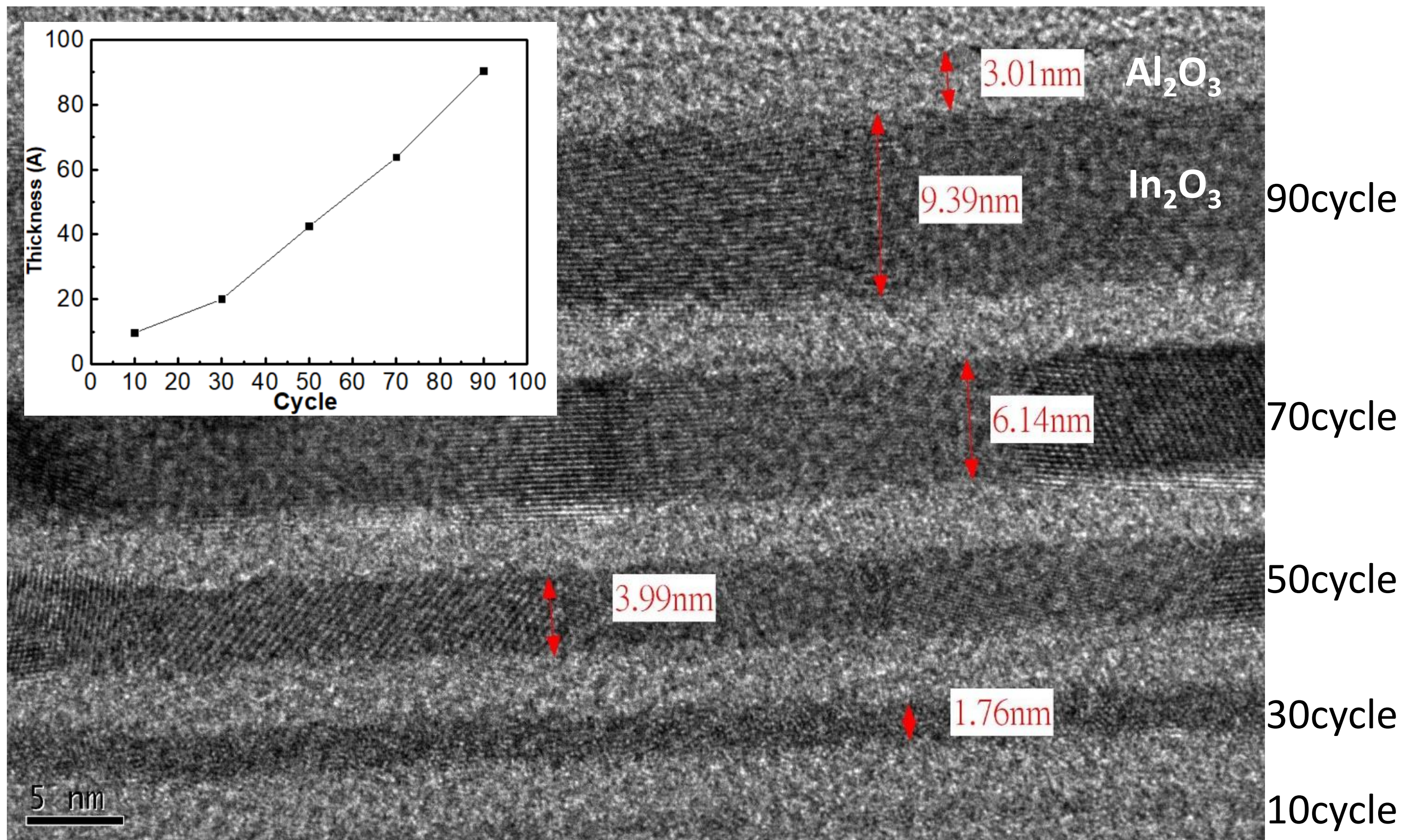


ALD cycles vs thichness

Item	Status	Methodology
PEALD InOx	T_{dep} at 250 °C	TEM

Al2O3 (40 cycles)
PEALD In2O3 (90 cycles)
Al2O3 (40 cycles)
PEALD In2O3 (70 cycles)
Al2O3 (40 cycles)
PEALD In2O3 (50 cycles)
Al2O3 (40 cycles)
PEALD In2O3 (30 cycles)
Al2O3 (40 cycles)
PEALD In2O3 (10 cycles)
Al2O3 (40 cycles)
Dry oxide (500A)
Si (100) substrate

- T_{dep} = 250 °C



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ALD film uniformity

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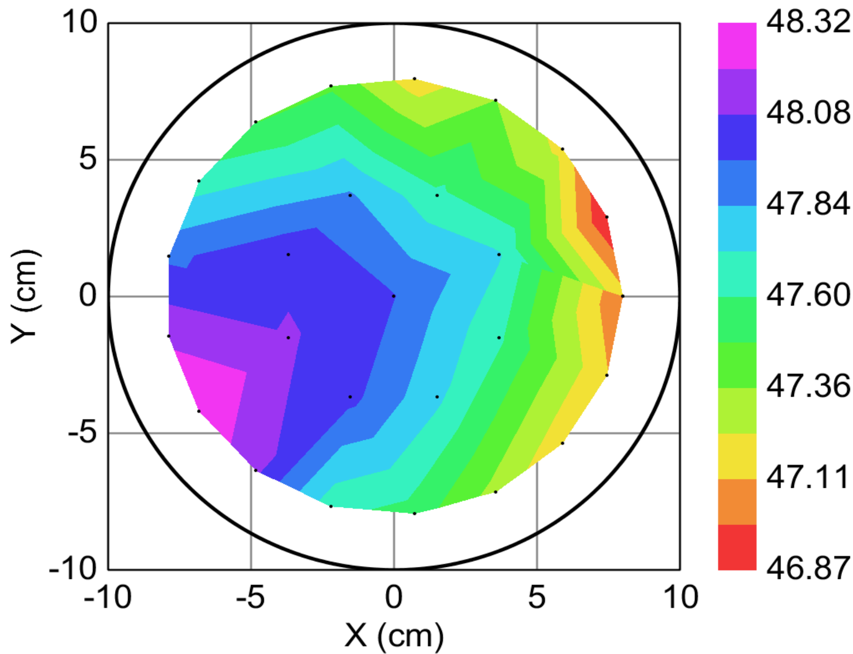
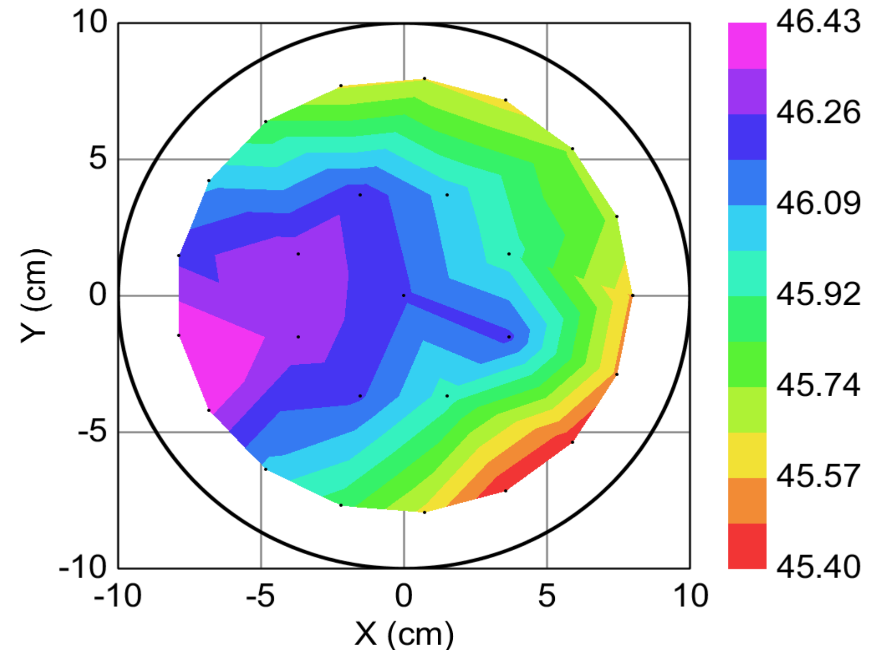
Item	Status	Methodology
PEALD InOx	50cycles T_{dep} at 250 °C	Ellipsometer

Data source: 2023/4/14





Position (cm)	Thickness # 2 (Å)
Average	47.6
Min.	46.87
Max.	48.32
Std. Dev.	0.4
% Range	1.52

Position (cm)	Thickness # 2 (Å)
Average	45.92
Min.	45.4
Max.	46.43
Std. Dev.	0.31
% Range	1.12

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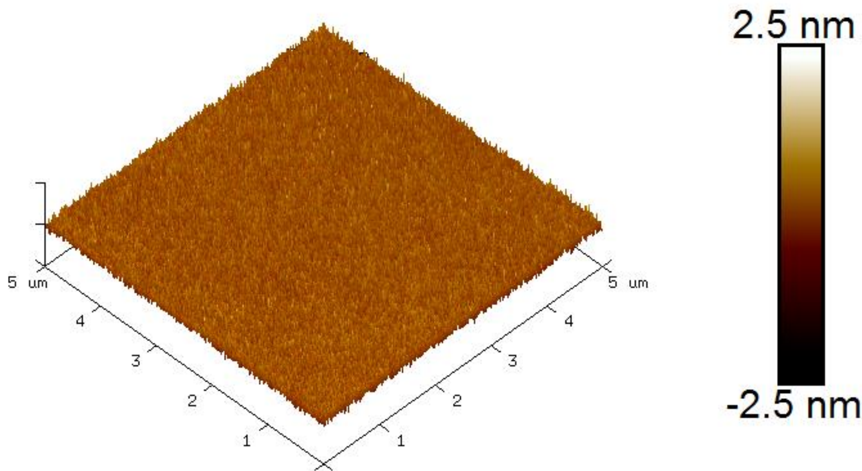
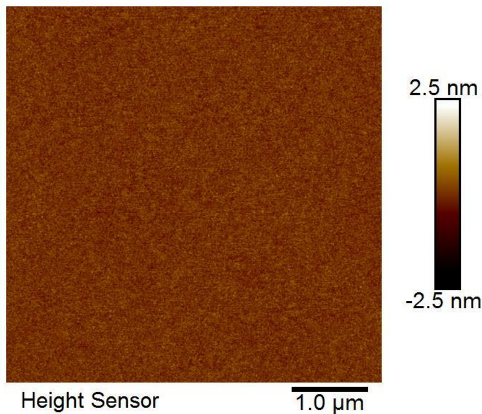
ALD film roughness

Item	Status	Methodology
PEALD InOx	50cycles T_{dep} at 250 °C	AFM



Height Sensor



8 positions on a 8 inch wafer	Image Root Mean Square (nm)
112-017-0110-edge(-2,-4).0_00001.spm	0.191
112-017-0110-edge(-2,-4).0_00000.spm	0.162
112-017-0110-edge(1,4).0_00001.spm	0.166
112-017-0110-edge(1,4).0_00000.spm	0.188
112-017-0110-center(-1,-1).0_00001.spm	0.198
112-017-0110-center(-1,-1).0_00000.spm	0.209
112-017-0110-center(1,-1).0_00001.spm	0.206
112-017-0110-center(1,-1).0_00000.spm	0.214
Average	0.19175
Std Dev (nm)	0.019263

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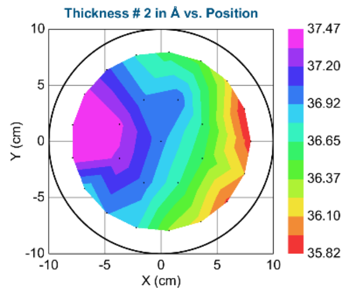
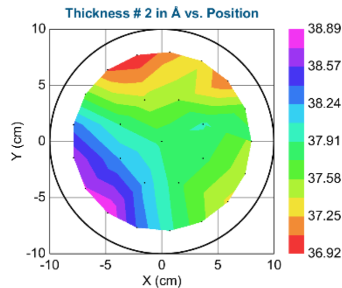
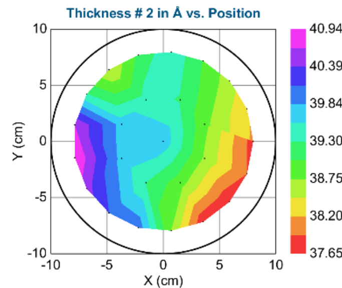
ALD film repeatibility

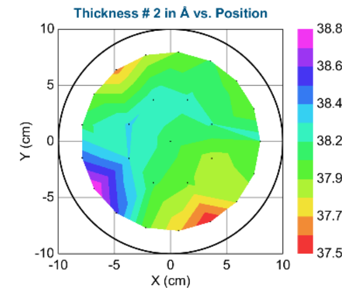
Item	Status	Methodology
PEALD InOx	40cycles T_{dep} at 250 °C	Ellipsometer

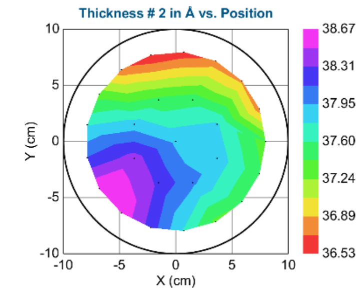
Date	Criteria		Measurement		
	Within wafer	Wafer to wafer	Max (Å)	Min (Å)	Range (Å)
2024/1/8	1.46 %	1.58 %	39.11	36.68	2.43











Avg (Å)	Std. Dev.	U (%)
36.68	0.52	1.4%

Avg (Å)	Std. Dev.	U (%)
37.79	0.51	1.3%

Avg (Å)	Std. Dev.	U (%)
39.11	0.9	2.3%

Avg (Å)	Std. Dev.	U (%)
38.1	0.27	0.7%

Avg (Å)	Std. Dev.	U (%)
37.59	0.61	1.6%

U (%) = (Std. Dev./Avg)*100 %