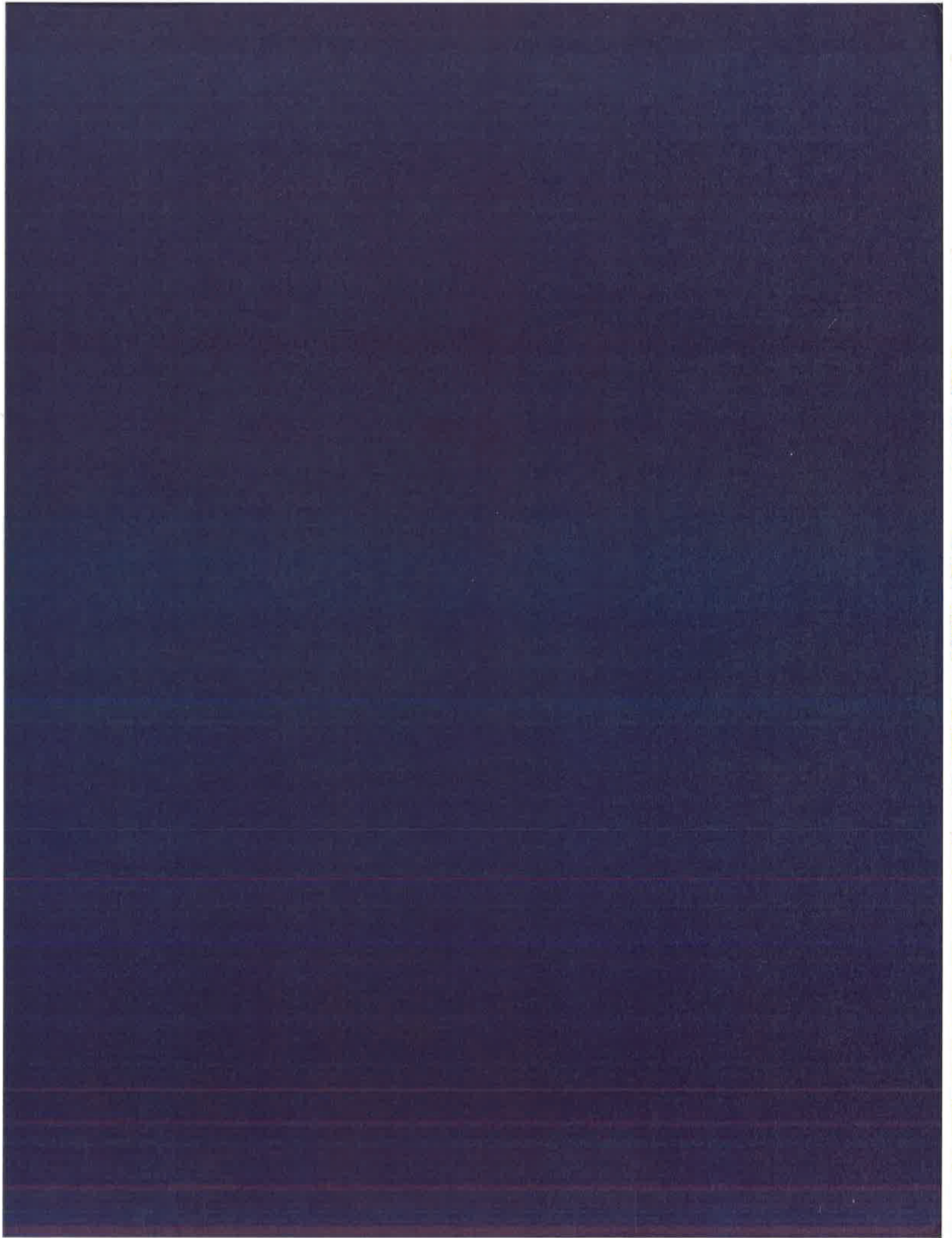






OMVPE III Run # 111308date: 1/7/98operator: SASdescription: REPEAT of 111305program used for this run: MANUAL

growth segment	time	actual susceptor temp	TC temp	RF amps
1/2 clean	10 min			46
91 GaN	60 min			46

rotation speed: -0.1 cell press: 75 vent press: +1zone I manifold temp: 57.6 OM3 heat tape: 52.6NH3 cylinder: (left/right) start weight/press: 29 lbs / 90 psi heat tape voltage: Ø
finish weight/press: 28 lbs / 80 psi

	OM1	OM2	OM3	OM4	OM5	OM6
temp			30.0		16.5	
grams used			2.08			
mfc offset			0.0		0.1	
Pres. closed			161.6		688.6	

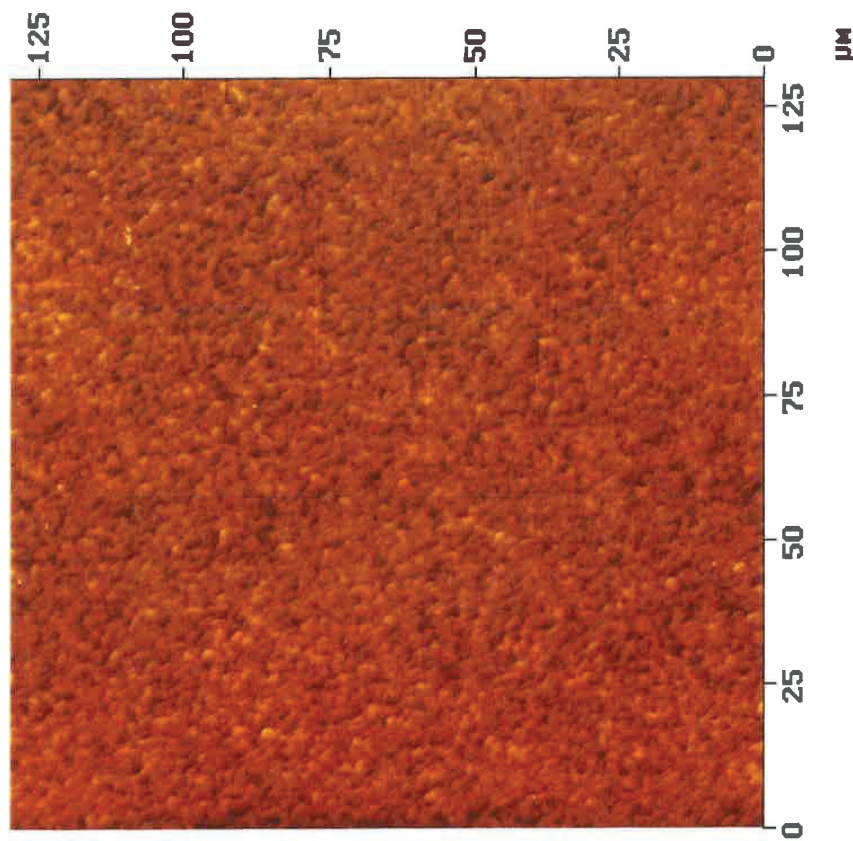
wafers:

1 sic wafer
cleaved in udb
from larger 1/4 waferSolvent + RCA prep on 12/26/97
from wafer AE Ø 56-71 sapphire pc
1/4 wafer pc from 2" sapphire
from box 97-1033
Solvent clean.

time	volts	comments	TEG (OM3)	NH3 zone1	NH3 block	Cell Throttle	RF lead Can (TC)
	30A	RF ON					16.4
	30A	TMA TO VENT				24.9/699.1	26 183 20
13:32	115 30A	BALANCE W					
	180 30A						
13:34	100 215 48A	TURNED UP RF				24.9/689.2	23.2 27
13:40	627 794 48A	NH3 ENGAGED LINE CHARGED				25.1/690.5	50.1 29
13:42:45	700 837 46A	START 10min bake					
13:43:45	733 845 46A	TEG TO VENT	24.1 151.9			25.0	55.2 30
13:49:45	781 859 46A	TURNED UP TEG	89.2 160.7			25.2	59.5 31
13:52:45	800 864 46A	NH3 line to cell 2 sec 4 min TMA TEG TO CELL WAIT 4 min then activate NH3 line * VERIFIED ROTA * TURN ON NH3 Thro V10 +	89.2 164.9	15-4	8.3	25.1	60.5 31
13:56:45	805 868 46A		89.1 169.1	15.5	8.9	25.0 689.2	60.9 32
14:05	812 872 46A		89.1	15.3	8.1	25.1 695.2	61.3 32
14:12	809 869 46A		89.2	15.3	8.2	25.1 699.5	61.5 32
14:27	810 868 46A		89.2	15.3	8.2	25.1 699.1	61.4 32
14:42	809 870 45-6A		89.2	15.3	8.2	25.2 699.8	61.9 32
14:52:45	811 871 46A		89.2 161.6	15.3	8.2	25.2 699.6	62 32

Height Angle Surface Normal Clear Calculator

50.0 nm
25.0 nm
0.0 nm

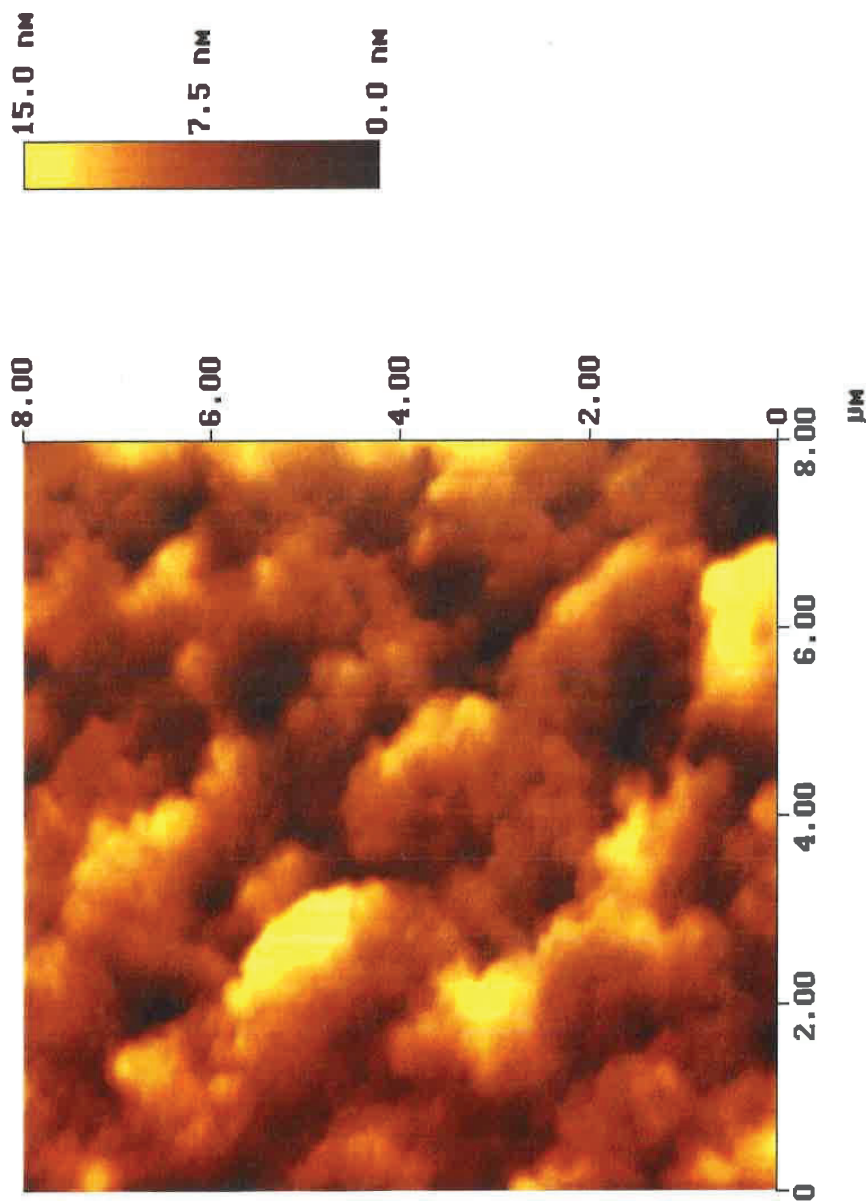


iii308w1: Bulk GaN growth on SiC

AlGaN LAYER w/om ppeflow

Height

Height Angle Surface Normal Clear Calculator



iii308w1: Bulk GaN growth on SiC
ALGaN LAYER w / om preflow

Height



OMVPE III Run # 111310 date: 1/9/98 operator: JAS

description: Thick GaN layer on top of $\approx 2000\text{\AA}$ of
AlGaN. AlGaN is linearly graded to GaN @ interface.

program used for this run: MANUAL

growth segment	time	actual susceptor temp	TC temp	RF amps
H ₂ GaN	10 min			46
AlGaN	30.5 min			46
GaN	270 min			46

rotation speed: -0.1 cell press: 75 vent press: +1

zone I manifold temp: 63.3 OM3 heat tape: 52.1

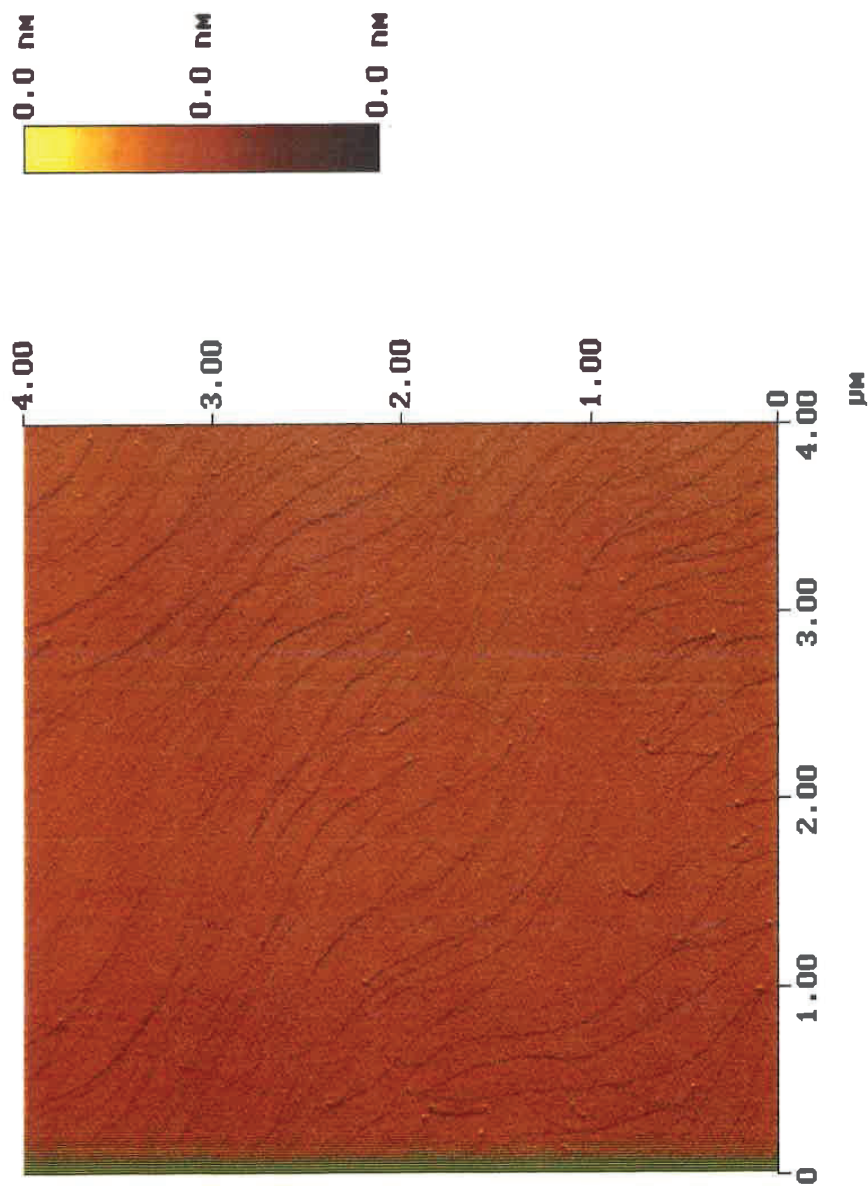
NH₃ cylinder: (left/right) start weight/press: 27 lbs / 96 psi heat tape voltage: ✓
 finish weight/press: _____ up to 60 volts
 16.22

	OM1	OM2	OM3	OM4	OM5	OM6
temp			30.0		16.5	
grams used			16.5			
mfcoffset		~~0.0~~	0.0		0.0	
Pres. closed						

wafers: 1 sic N+ wafer 1 sic SI wafer 1 sapphire wafer $95\text{\AA}/\text{min} = 263\text{ min}$
 1/6th wafer 1/4 wafer from 1/4 wafer from for 2.5um
 from wafer 1 3/8" SI sic 2" from box
 * AA $\phi 1\phi 9-1\phi$ * F0728-2 * 97-1033
 Solvents + RCA prep solvents + RCA prep
 on 1/8/98 on 1/8/98

time	TC temp	RF: amps/volts	comments	TEG (OM3)	NH3 zone I	NH3 block	Cell Throttle	RF lead Can (TC)
								12.7
15:51	43/72	30A					24.9	
15:52		30A	TMA to vent.				693.7	
15:53	50/146	30A	BALANCE IN				25.0	16.9/25
15:56	104/272	48A ↑	TURNED UP RF.				694.4	20.2/26
16:03	655/815	48A	VISUALLY CHECKED ROTATION. TEG IN	25.3/151.5	-	-	25.0	48.4/29
16:04	710/842	↓ 46A	Start 10 min Hz clean.					
16:08	768/860	46A	TURN UP REG (16:12)	25.1/89.0	-	-	25.0	53.0/30
16:14W	777/873	46A	4 min delay men inject UH3.	89.2/164.4	15.2	8.9	24.7/692	55.9
16:19W	808/877	46A.	ALGARD STARTED 30.5 min.	89.2	15.4	9.2	25.1/695.5	56.9/31
16:29	815/880	46A		89.3	15.2	8.5	25.2/693.6	57.8/31
16:34	819/882	46A		89.3	15.2	8.5	25.2	57.7/31
16:49W	811/878	46A	START GRADING BACK AI down to 2% (4.5 hrs)					
16:51W	816/883	46A.	INCREASE NH3 FLOWS. Then switched out.					
			Finished moving up NH3	89.3	30.4	17.5	TMA ISOLATED	58.2/32
			NH3 CP line up to 16 psi				689.2	
16:53	815/877	46A		89.3/177.4	30.4	17.0		57.9/32
17:34	813/875	46A		95.6/177.4				
18:02	809/872	46A		95.6/177.4	30.4	17.0		57.1/32
19:17	813/879	46A		95.6/177.0	30.4	17.1		57.4/32
19:18	816/883	46A		95.7/177.6	30.4	17.1		57.8/32
20:11	814/880	46A		95.6/177.2	30.4	17.0		57.8/32
21:19W	814/878	46A.	RUN OVER	95.6/	30.4	17.1		57.8/32

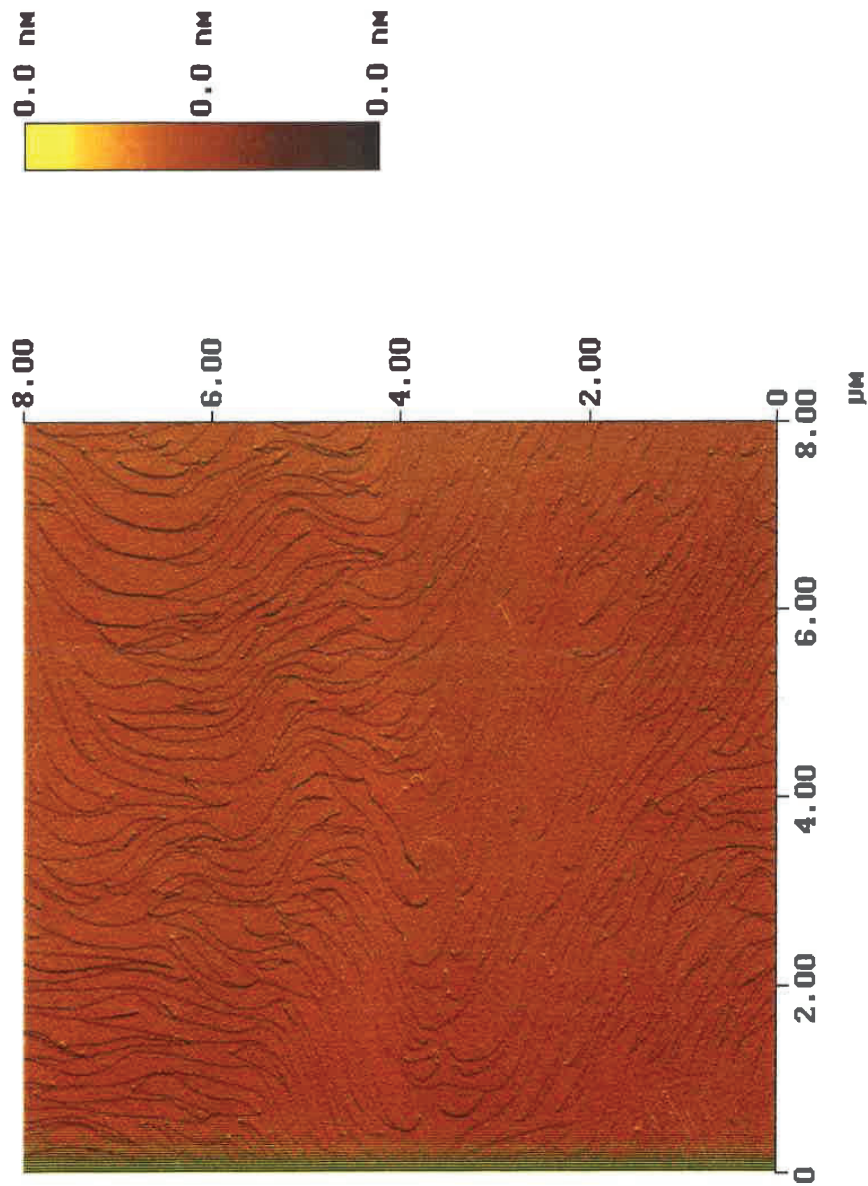
Height Angle Surface Normal Clear Calculator



iii310w1: Bulk AlGaIn/GaN on SiC (deflection)

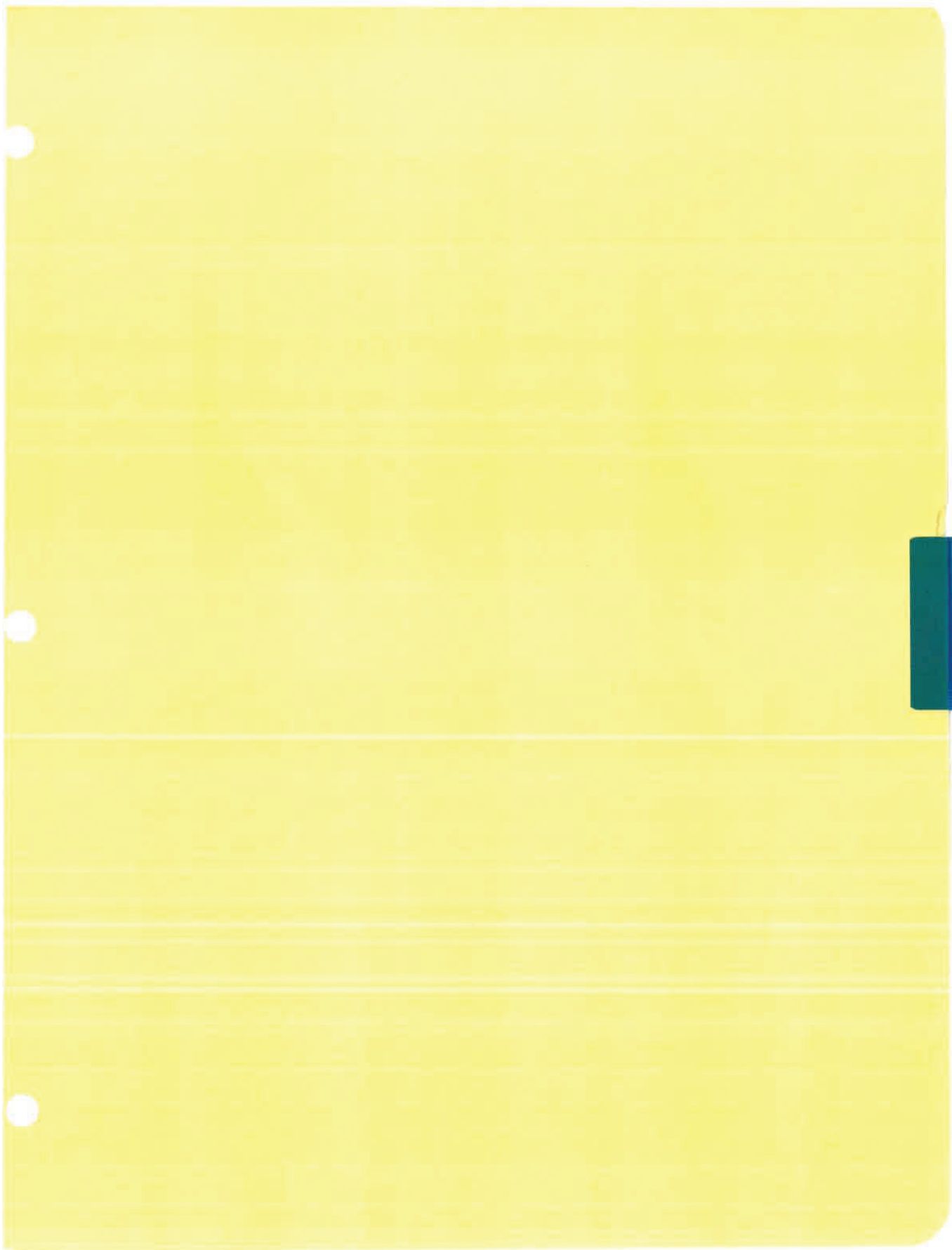
Height

Height Angle Surface Normal Clear Calculator



iii310w1: Bulk AlGaIn/GaN on SiC (deflection)

Height



OMVPE III Run # 11313 date: 1/18/98 operator: TS

description: This run was first aborted on 1/7/98
due to rotation problem with reactor

program used for this run: - MANUAL -

growth segment	time	actual susceptor temp	TC temp	RF amps
H ₂ clean	10 min	1040		46
AlGaIn	30.5 min	1040		46
(4 min pre flow of OM's)				46

rotation speed: 0.1 cell press: 75 vent press: +1

zone I manifold temp: 51.3 OM3 heat tape: 52.5

NH₃ cylinder: (left/right) start weight/press: 94 psi / 50 lbs heat tape voltage: 0
finish weight/press: _____

	OM1	OM2	OM3	OM4	OM5	OM6
temp			30.0		16.5	
grams used			1.51			
mfc offset			0.0		0.0	
Pres. closed						

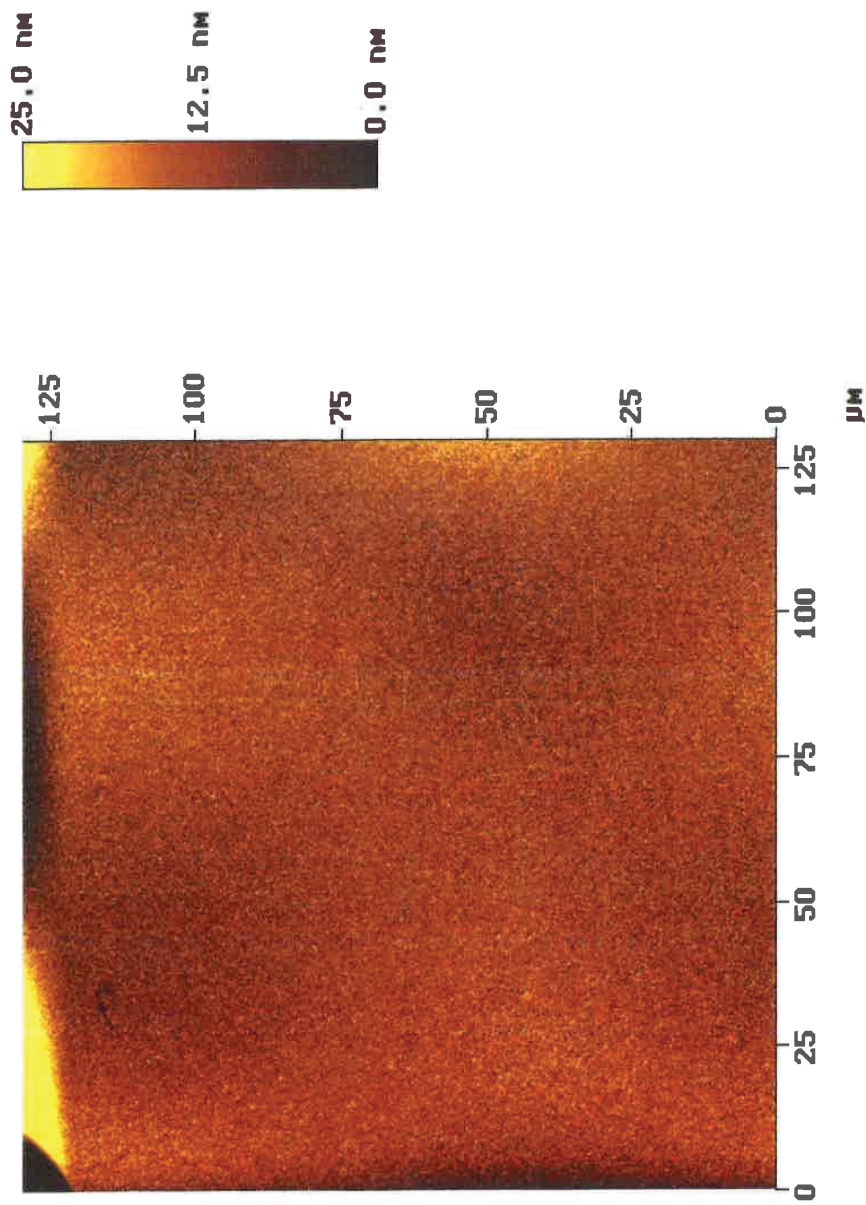
wafers:

1 sic nit wafer
1/6 in wafer pc
from wafer
AA0109-10
solvents + RCA prep
on 1/14/98

1 sapphire wafer
1/4 wafer pc
from 2" wafer
from box 97-1033
solvent clean

time	TC temp	RF: amps/volts	comments	TEG (OM3)	NH3 zone I	NH ₃ block	RF load Car
12:09	~~32~~ 56	30A	RF ON				
12:13	42/ 177	30A	Start NH ₃ purge Start TMA.				25.5 297.6
12:14	5/ 221	30A	balance in				18.
12:16	100 ~~307~~	30A ↑ 48A	increase RF				25.2/ 297.5
12:21	~~565~~ 813	48A	NH ₃ buoyant		15.3		25.3/ 298.3
12:24	~~725~~ 894	↓ 46A	increased TMA flow start 10 min	H ₂ flow	15.0		48.0/ 305.1
12:26	749/ 902	46A	Start TEG	~~26.1~~ 152.3	15.0		47.5
12:29	~~765~~ 909	46A	increase TEG	26.1 89.3	15.0		47.6
12:3500	~~804~~ 916	46A	4 min amp reslow	89.2 165.1	15.1	8.8	47.5/ 305.6
12:3900	~~806~~ 915	46A	NH ₃ into zone I + block	89.3	15.2	8.9	47.6/ 306.1
12:43	~~813~~ 920	46A		89.3	15.1	8.8	47.6/ 306.3
12:56	~~820~~ 916	46A		89.3	15.1	8.8	47.5/ 306.4
13:05	~~820~~ 916	46A		89.3	15.1	8.8	47.6/ 306.4
13:0930	~~824~~ 917	↓ OFF	Run over	89.3 161.9	15.1	8.8	47.6/ 306.4

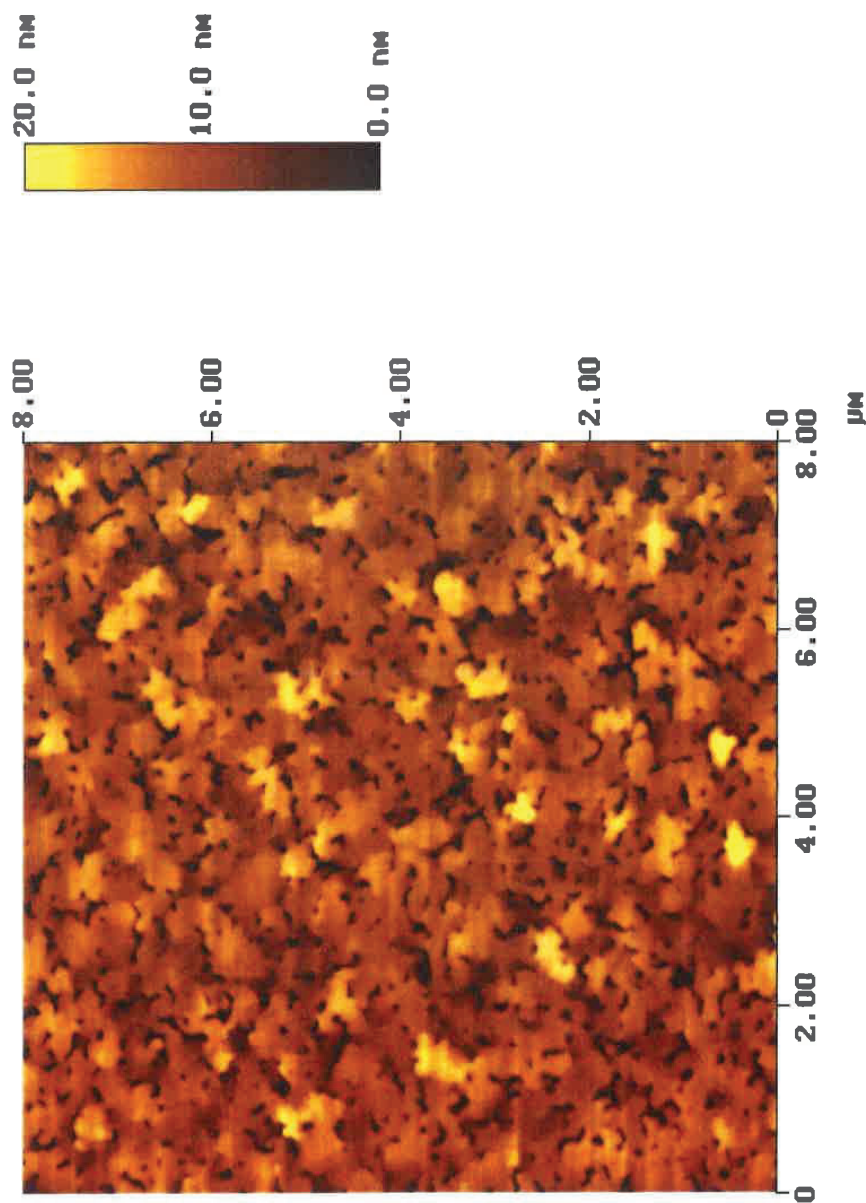
Height Angle Surface Normal Clear Calculator



iii313w3: Bulk GaN growth on α -Al₂O₃

Height

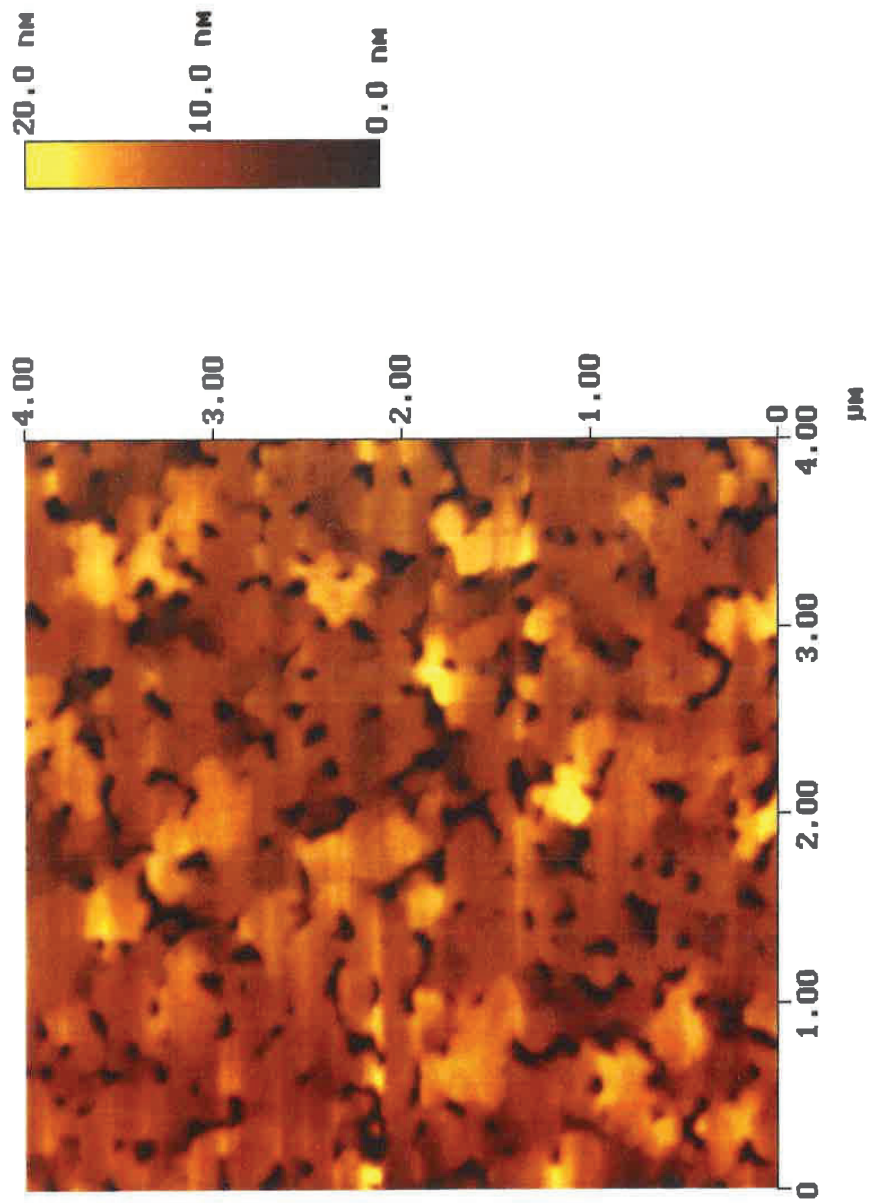
Height Angle Surface Normal Clear Calculator



iii313w3: Bulk GaN growth on α -Al₂O₃

Height

Height Angle Surface Normal Clear Calculator



iii313w3: Bulk GaN growth on α -Al₂O₃

Height

iii 333

OMVPE III Run # 11333

date: 2/24/98 operator: JAS

description: PATTERNED SUBSTRATES. ELO Project.

Problems with Ntlz line between AlGaIn buffer
and GaN layer.

program used for this run: -MANUAL-

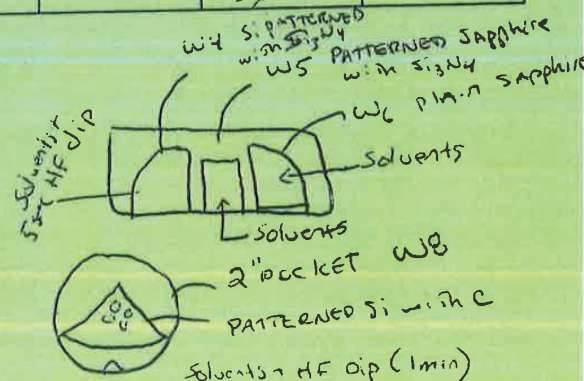
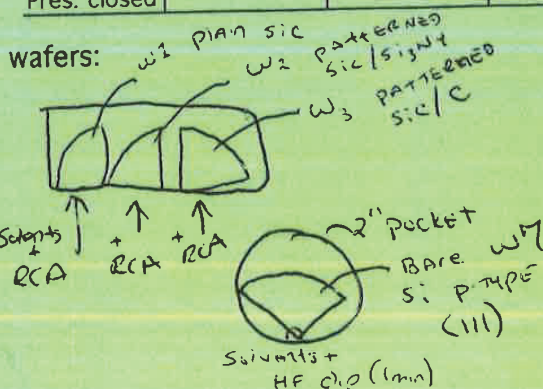
V/III RATIO	growth segment	time	actual susceptor temp	TC temp	RF amps
$\frac{1}{\phi}$ ≈ 900 ≈ 1800 ≈ 31 ≈ 1800	H ₂ bake	10min			43-4
	Om preflow	4min			44
	AlGaIn Buffer ($\approx 6-7\%$ Al)	30min			44
	GaN Layer	420min			43
	AlGaIn cap layer (200-250Å)	2min			43

rotation speed: -0.1 cell press: 75 vent press: +1

zone I manifold temp: 52.5 OM3 heat tape: 59.0

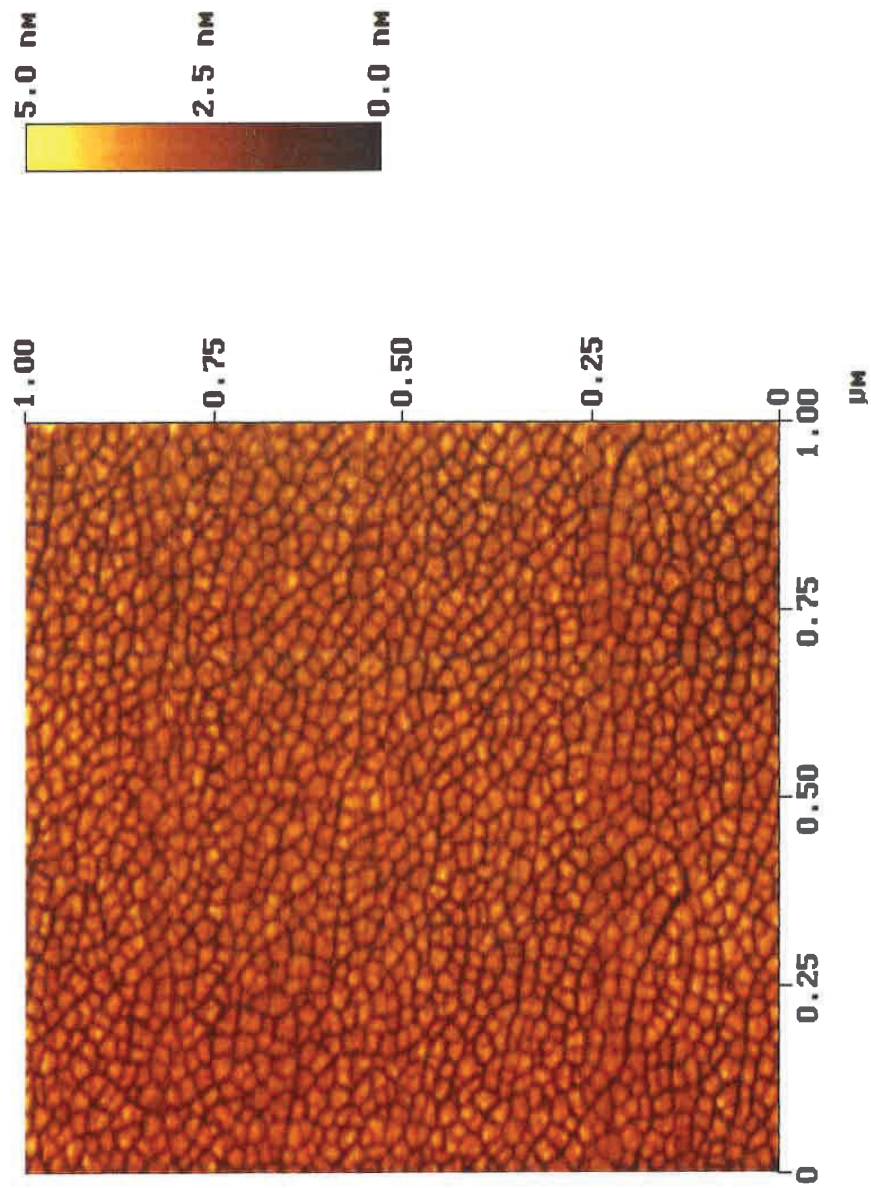
NH₃ cylinder: (left/right) start weight/press: 39lbs/95psi heat tape voltage: 60V
finish weight/press: _____

	OM1	OM2	OM3	OM4	OM5	OM6
temp			30.1		16.4	
grams used						
mfc offset			0.0		0.0	
Pres. closed			163		159	



	temp	RF	comments	TMA	TEG (OM3)	NH3 zone1	NH3 block	Cell Throttle	RF lead Can (TC)
		30A	RF on					4.9	12.9 / 25
		30A	BALANCE in					5.3	19.4 / 26
	100	48A	Purge NH3 line TURN UP RF.					5.3	20.0 / 26
12:28	493 / 970	48A	Charged NH3 line.						
12:30	639 / 1038	48A	NH3 to vent GETTING IN			2.9		4.8	52.1 / 28
12:32	725 / 1055	43A ↓	Start bake. 10 min.			3.1 ↑		4.8	55.1 / 29
12:33	757 / 1019	TMA ON 43A	Change over Pressure.	15.3 / 1575	700				
12:35	775 / 1023	TEG ON 43-44	TEG ON	25.4 / 713	15.1 / 151.7	15.0	-	4.8	56.7 / 29
12:46:01	793 / 1031	44A	Gun prep for 4 min.	25.1 / 696.4	89.4 / 157.4	15.3	-	5.3	59.0 / 30
12:48:20	796 / 1038	44A		25.3	89.4 / 157.4	15.3	-	5.4	59.4 / 30
12:50:10	800 / 1039	44A	NH3 in 16 hrs (Aluminum)	25.0 / 687.7	89.4 / 157.4	15.4	0.0	5.5	59.7 / 30
12:52	801 / 1039	44A		25.2 / 695.8	89.4 / 164.6	15.2	5.6	5.6	59.9 / 30
13:00	801 / 1036	44A		25.1 / 692	89.4	15.2	5.7	5.7	60.1 / 31
13:20	800 / 1037	44A	Ramp out AL 4 min to 270 Then INCREASE VIR ratio	27.0	89.4 / 164.5	15.1	8.6	5.9	60.5 / 31
13:33	798 / 1036	44A	TMA isolated	69.1	89.4 / 172.1	30.0	17.0	6.3	60.6 / 31
			HAD BIG Problem with NH3 !!!						
			Got flow up to 60% in ZONE I						
			105 T DP ACROSS GETTING MEET,						
			Then dropped to 5 Torr!! sent						
			the machine into oscillations!!!						
			could have lost NH3 flow in the block!						
14:17	805 / 1040	44		11.2 / X	89.4 / 172	30.0	17.0	6.4	61.1 / 31
14:37	802 / 1043	44		X	89.4 / 172.1	30.0	17.0	6.4	60.9 / 31
14:41	803 / 1042	44			89.4 / 172	30.0	17.1	6.4	61.5 / 32
15:50	802 / 1041	43A			89.4 / 172.9	30.0	17.1	6.4	61.3 / 32

Height Angle Surface Normal Clear Calculator

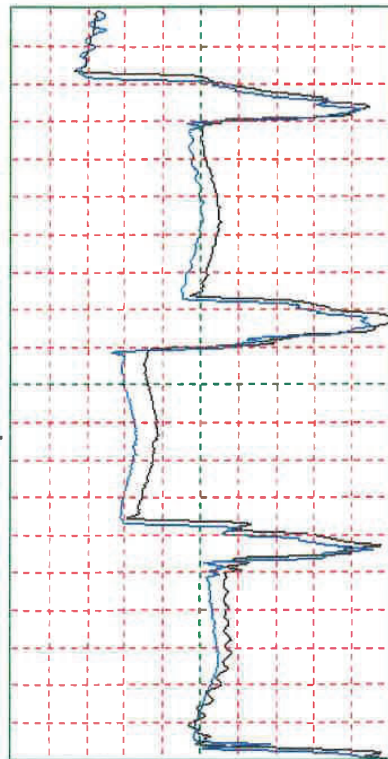


III333w2/A-2: 4um window region (cntr, zoom)

Height

Scope Trace

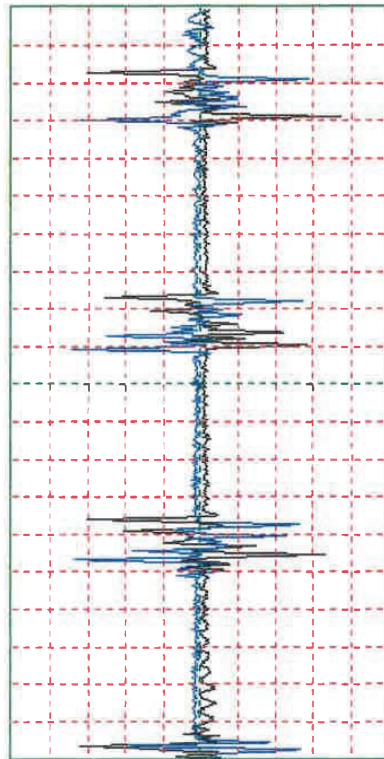
Z Range
15.00 nm/div



Left Trace

→ Trace
← Retrace

Z Range
1.50 nm/div



Right Trace

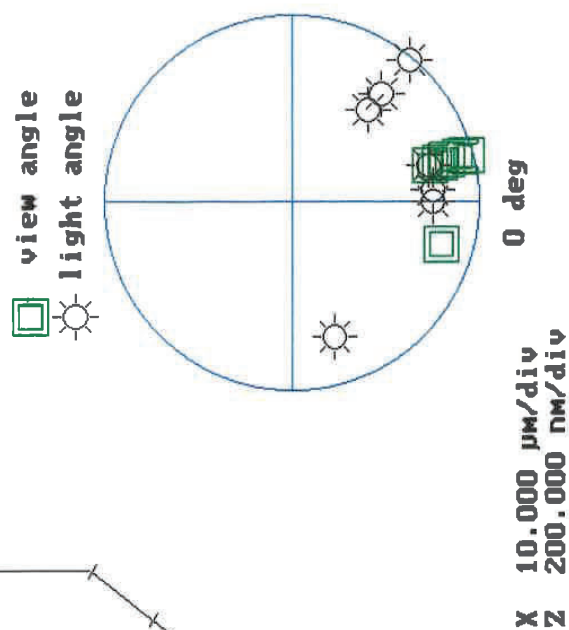
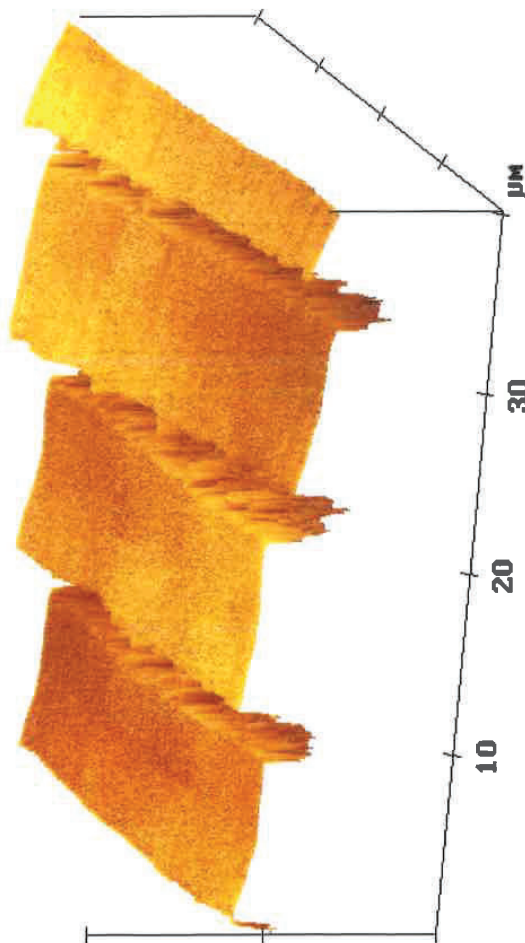
2.46 ms/div

III333w2/A-2: Semi-coalesced 4:8 ELO stripes

333w2a2.004

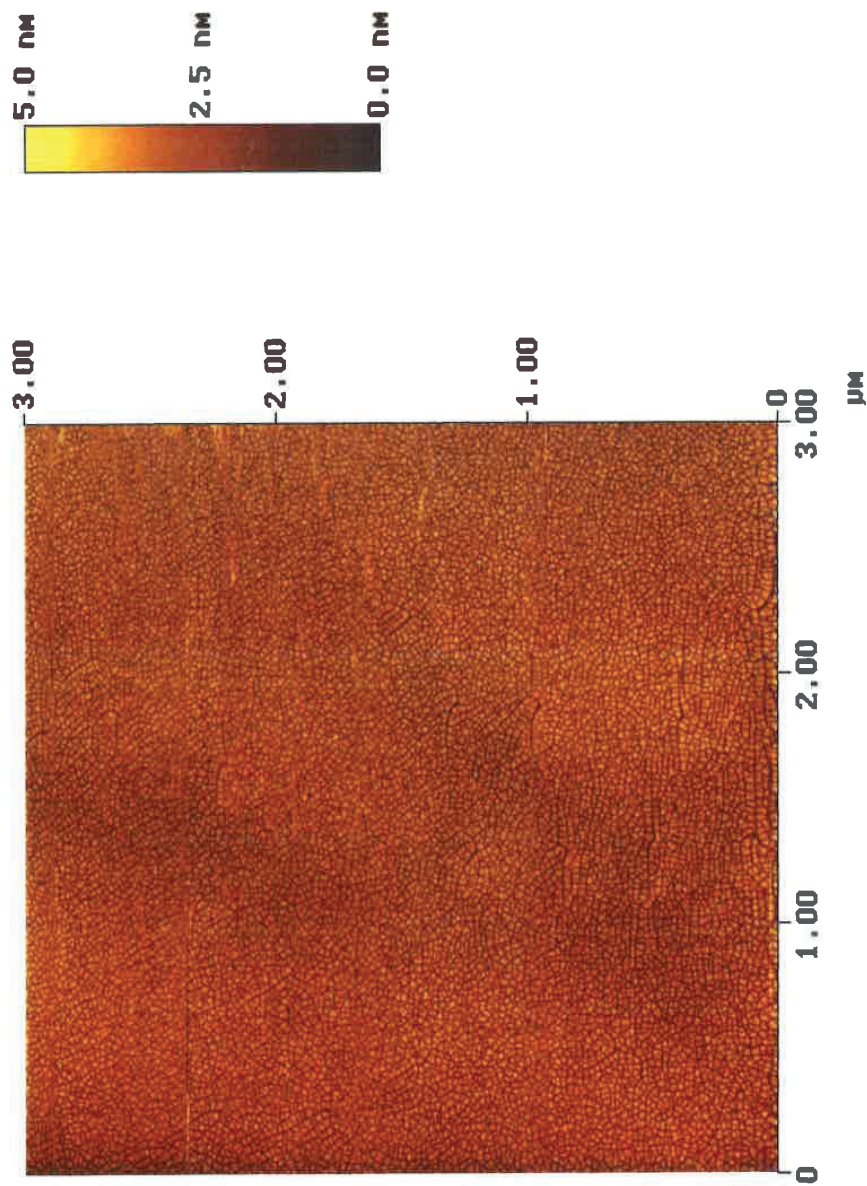
Scan date: 2-27-98

NanoScope	Contact AFM
Scan size	39.97 μm
Setpoint	0 V
Scan rate	1.969 Hz
Number of samples	512



III333w2/A-2: Semi-coalesced 4:8 ELO stripes on $\alpha\text{-Al}_2\text{O}_3$ w/ Si_3N_4 mask

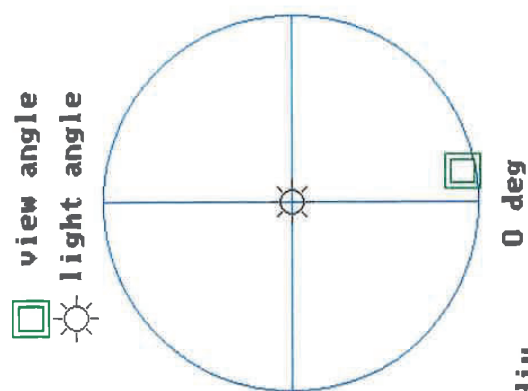
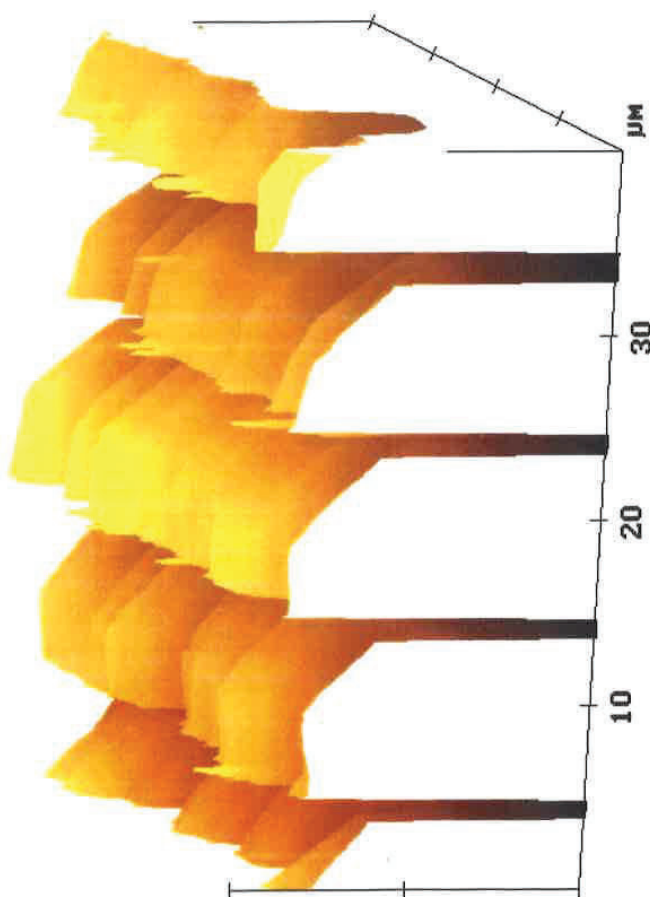
Height Angle Surface Normal Clear Calculator



III333w2/A-2: 4um window region (centered)

Height

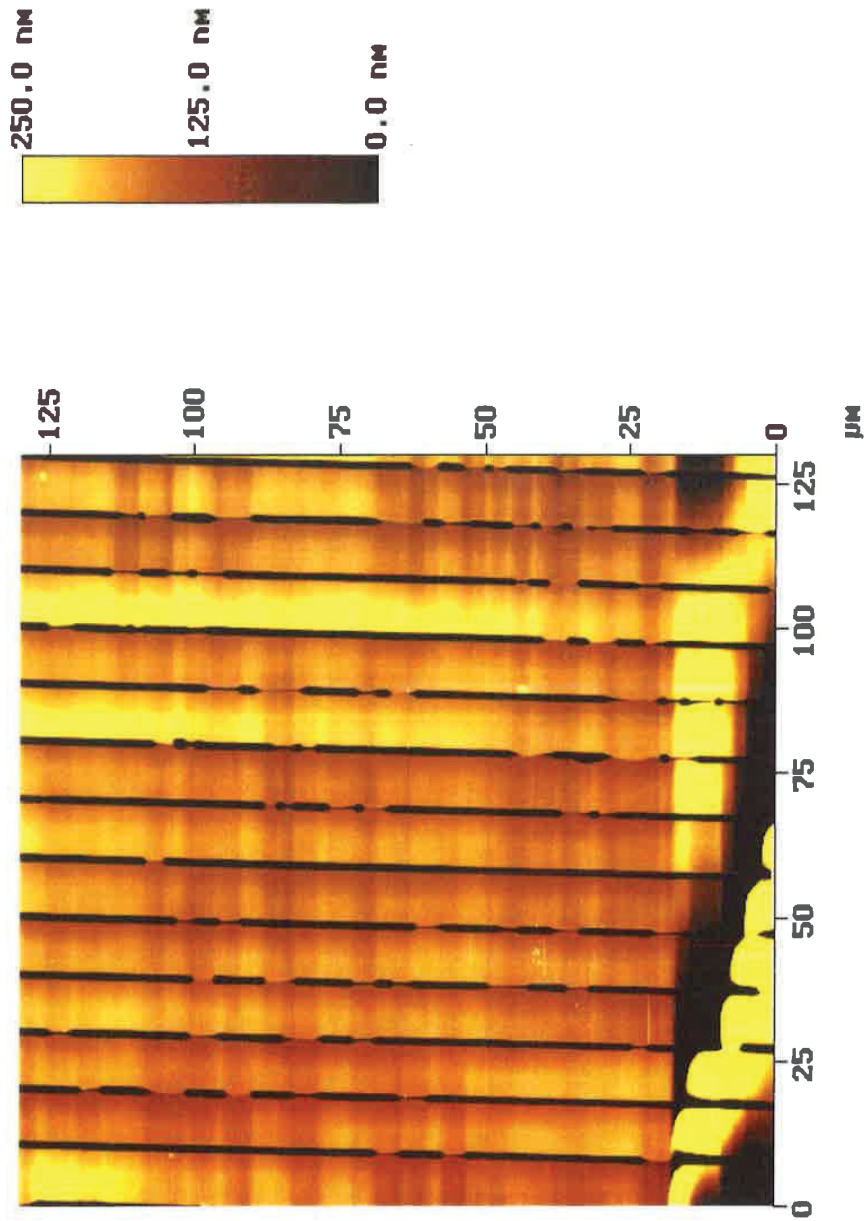
NanoScope	Contact AFM
Scan size	40.00 μm
Setpoint	0 V
Scan rate	1.969 Hz
Number of samples	512



X 10.000 $\mu\text{m}/\text{div}$
Z 100.000 nm/div

iii323w6: AlGaIn/GaN ELO w/ 8:2 stripe geometry

Height Angle Surface Normal Clear Calculator



iii323w6: AlGaIn/GaN ELO w/ 8:2 stripe geometry

Height

6/02-0051

