

# BATCH MANUFACTURING RECORD

## STM Hydrogen Desorption Lithography Process

Batch Number:	_____	Date Started:	_____
Device ID:	_____	Target Completion:	_____
Sample:	_____	Actual Completion:	_____
Primary Operator:	_____	QC Review:	_____

### Step 1: Sample Preparation & Cleaning

Operator Initials:	_____	Start Time:	_____	End Time:	_____
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#### Process Parameters:

Parameter	Specification	Actual Value	Within Spec?
Cleaning Method	Acetone + IPA ultrasonic	_____	■ Yes ■ No
Inspection Result	No visible contamination	_____	■ Yes ■ No

#### Quality Checks:

✓	Check Description	Pass/Fail
■	Surface cleanliness	■ Pass ■ Fail
■	No visible contamination	■ Pass ■ Fail

<b>Notes / Observations:</b>

Completed by:	_____	Date/Time:	_____
Verified by:	_____	Date/Time:	_____

### Step 2: Sample Loading & Pumpdown

Operator Initials:	_____	Start Time:	_____	End Time:	_____
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**Process Parameters:**

Parameter	Specification	Actual Value	Within Spec?
Load Time	As required	_____	<input type="checkbox"/> Yes <input type="checkbox"/> No
Base Pressure (Torr)	< 1×10 <sup>■■■</sup>	_____	<input type="checkbox"/> Yes <input type="checkbox"/> No

**Quality Checks:**

✓	Check Description	Pass/Fail
<input type="checkbox"/>	Loadlock pressure < 5×10 <sup>■■■</sup> mbar	<input type="checkbox"/> Pass <input type="checkbox"/> Fail

**<b>Notes / Observations:</b>**

**Completed by:** \_\_\_\_\_

**Date/Time:** \_\_\_\_\_

**Verified by:** \_\_\_\_\_

**Date/Time:** \_\_\_\_\_

### Step 3: Degas

Operator Initials: _____	Start Time: _____	End Time: _____
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#### Process Parameters:

Parameter	Specification	Actual Value	Within Spec?
Temperature (°C)	200-300	_____	■ Yes ■ No
Duration (min)	30-120	_____	■ Yes ■ No
Pressure During (Torr)	< 5×10■■■	_____	■ Yes ■ No

#### Quality Checks:

✓	Check Description	Pass/Fail
■	Target temperatures reached	■ Pass ■ Fail
■	Pressure stable	■ Pass ■ Fail

<b>Notes / Observations:</b>

Completed by: _____	Date/Time: _____
Verified by: _____	Date/Time: _____

### Step 4: Flash Clean

Operator Initials: _____	Start Time: _____	End Time: _____
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#### Process Parameters:

Parameter	Specification	Actual Value	Within Spec?
Flash Temperature (°C)	1200 ± 50	_____	■ Yes ■ No
Flash Duration (s)	5-10	_____	■ Yes ■ No
Flash Current (A)	Per calibration	_____	■ Yes ■ No

#### Quality Checks:

✓	Check Description	Pass/Fail
■	Temperature profile correct	■ Pass ■ Fail
■	Surface reconstructed	■ Pass ■ Fail

<b>Notes / Observations:</b>

Completed by: _____	Date/Time: _____
Verified by: _____	Date/Time: _____

## Step 5: H-Termination

Operator Initials: _____	Start Time: _____	End Time: _____
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### Process Parameters:

Parameter	Specification	Actual Value	Within Spec?
Temperature (°C)	330 ± 5	_____	■ Yes ■ No
H■ Pressure (Torr)	1×10■■■	_____	■ Yes ■ No
Dose Time (s)	As required	_____	■ Yes ■ No
Dose (Langmuirs)	~ 1000 L	_____	■ Yes ■ No

### Quality Checks:

✓	Check Description	Pass/Fail
■	Temperature 330°C ± 5°C	■ Pass ■ Fail
■	Uniform H coverage	■ Pass ■ Fail

<b>Notes / Observations:</b>

Completed by: _____	Date/Time: _____
Verified by: _____	Date/Time: _____

## Step 6: STM Imaging Pre-Lithography

Operator Initials: _____	Start Time: _____	End Time: _____
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### Process Parameters:

Parameter	Specification	Actual Value	Within Spec?
Scan Area (nm)	As required	_____	■ Yes ■ No
Bias (V)	Typically -2.0 to +2.0	_____	■ Yes ■ No
Setpoint (pA)	10-100	_____	■ Yes ■ No

### Quality Checks:

✓	Check Description	Pass/Fail
■	Atomically resolved	■ Pass ■ Fail
■	Terrace quality acceptable	■ Pass ■ Fail

**<b>Notes / Observations:</b>**

**Completed by:** \_\_\_\_\_

**Date/Time:** \_\_\_\_\_

**Verified by:** \_\_\_\_\_

**Date/Time:** \_\_\_\_\_

## Step 7: STM Lithography

Operator Initials: \_\_\_\_\_ Start Time: \_\_\_\_\_ End Time: \_\_\_\_\_

### Process Parameters:

Parameter	Specification	Actual Value	Within Spec?
Pattern Design	Per device spec	_____	■ Yes ■ No
Litho Voltage (V)	6-8 V typical	_____	■ Yes ■ No
Desorption Speed	Per pattern	_____	■ Yes ■ No

### Quality Checks:

✓	Check Description	Pass/Fail
■	Pattern complete	■ Pass ■ Fail
■	Line quality good	■ Pass ■ Fail

<b>Notes / Observations:</b>

Completed by: \_\_\_\_\_ Date/Time: \_\_\_\_\_

Verified by: \_\_\_\_\_ Date/Time: \_\_\_\_\_

## Step 8: Post-Litho STM Imaging

Operator Initials: \_\_\_\_\_ Start Time: \_\_\_\_\_ End Time: \_\_\_\_\_

### Process Parameters:

Parameter	Specification	Actual Value	Within Spec?
Scan Area (nm)	Cover pattern	_____	■ Yes ■ No
Feature Measurements	Within design spec	_____	■ Yes ■ No

### Quality Checks:

✓	Check Description	Pass/Fail
■	Pattern verified	■ Pass ■ Fail
■	Dimensions within spec	■ Pass ■ Fail

<b>Notes / Observations:</b>

Completed by: _____	Date/Time: _____
Verified by: _____	Date/Time: _____



## Step 9: Dopant Dosing (PH3 or AsH3)

Operator Initials: _____	Start Time: _____	End Time: _____
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### Process Parameters:

Parameter	Specification	Actual Value	Within Spec?
Dopant Species	PH■ or AsH■	_____	■ Yes ■ No
Dose Pressure (Torr)	1×10■■■ to 1×10■■■	_____	■ Yes ■ No
Dose Duration (s)	As required	_____	■ Yes ■ No
Dose (Langmuirs)	Per design	_____	■ Yes ■ No

### Quality Checks:

✓	Check Description	Pass/Fail
■	Dose within spec	■ Pass ■ Fail
■	Pressure stable during dose	■ Pass ■ Fail

<b>Notes / Observations:</b>

Completed by: _____	Date/Time: _____
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Verified by: _____	Date/Time: _____
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## Step 10: Dopant Incorporation

Operator Initials: _____	Start Time: _____	End Time: _____
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### Process Parameters:

Parameter	Specification	Actual Value	Within Spec?
Temperature (°C)	350 ± 5	_____	■ Yes ■ No
Duration (s)	60-180	_____	■ Yes ■ No
Thermal Budget Δ (°C·s)	Track cumulative	_____	■ Yes ■ No

### Quality Checks:

✓	Check Description	Pass/Fail
■	Temperature 350°C ± 5°C	■ Pass ■ Fail
■	Surface morphology acceptable	■ Pass ■ Fail

**<b>Notes / Observations:</b>**

**Completed by:** \_\_\_\_\_

**Date/Time:** \_\_\_\_\_

**Verified by:** \_\_\_\_\_

**Date/Time:** \_\_\_\_\_

## Step 11: Post-Incorporation STM Imaging

Operator Initials: \_\_\_\_\_ Start Time: \_\_\_\_\_ End Time: \_\_\_\_\_

### Process Parameters:

Parameter	Specification	Actual Value	Within Spec?
Scan Area (nm)	Cover pattern	_____	■ Yes ■ No
Pattern Visibility	Features visible	_____	■ Yes ■ No

### Quality Checks:

✓	Check Description	Pass/Fail
■	Pattern still visible	■ Pass ■ Fail
■	No major defects	■ Pass ■ Fail

<b>Notes / Observations:</b>

Completed by: \_\_\_\_\_ Date/Time: \_\_\_\_\_

Verified by: \_\_\_\_\_ Date/Time: \_\_\_\_\_

## Step 12: Silicon Overgrowth - RT Phase

Operator Initials: \_\_\_\_\_ Start Time: \_\_\_\_\_ End Time: \_\_\_\_\_

### Process Parameters:

Parameter	Specification	Actual Value	Within Spec?
Growth Temp (°C)	25 (RT)	_____	■ Yes ■ No
Growth Time (s)	Per rate	_____	■ Yes ■ No
Target Thickness (nm)	~ 7 nm	_____	■ Yes ■ No

### Quality Checks:

✓	Check Description	Pass/Fail
■	Growth rate calibrated	■ Pass ■ Fail
■	Uniform coverage	■ Pass ■ Fail

<b>Notes / Observations:</b>

Completed by: _____	Date/Time: _____
Verified by: _____	Date/Time: _____

### Step 13: Silicon Overgrowth - RTA Anneal

Operator Initials: _____	Start Time: _____	End Time: _____
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#### Process Parameters:

Parameter	Specification	Actual Value	Within Spec?
Anneal Temp (°C)	550	_____	■ Yes ■ No
Anneal Time (s)	60	_____	■ Yes ■ No
Thermal Budget $\Delta$ (°C·s)	Track cumulative	_____	■ Yes ■ No

#### Quality Checks:

✓	Check Description	Pass/Fail
■	Temperature profile correct	■ Pass ■ Fail
■	No delamination	■ Pass ■ Fail

<b>Notes / Observations:</b>

Completed by: _____	Date/Time: _____
Verified by: _____	Date/Time: _____

### Step 14: Silicon Overgrowth - LTE Phase

Operator Initials: _____	Start Time: _____	End Time: _____
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#### Process Parameters:

Parameter	Specification	Actual Value	Within Spec?
Growth Temp (°C)	250	_____	■ Yes ■ No
Growth Time (s)	Per rate	_____	■ Yes ■ No
Total Thickness (nm)	~ 20 nm	_____	■ Yes ■ No

#### Quality Checks:

✓	Check Description	Pass/Fail
■	Target thickness achieved	■ Pass ■ Fail
■	Final thermal budget acceptable	■ Pass ■ Fail

<b>Notes / Observations:</b>

Completed by: _____	Date/Time: _____
Verified by: _____	Date/Time: _____

## FINAL REVIEW AND APPROVAL

<b>Review Item</b>	<b>Complete</b>	<b>Initials</b>
All process steps completed as specified	■	_____
All quality checks passed	■	_____
All parameters within specification	■	_____
All deviations documented and approved	■	_____
All required signatures obtained	■	_____
LabVIEW process files linked/attached	■	_____
STM scan files linked/attached	■	_____

### Final Approvals:

#### Quality Control Review:

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Printed Name: \_\_\_\_\_

#### Process Engineer Review:

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Printed Name: \_\_\_\_\_

#### Principal Investigator Approval:

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Printed Name: \_\_\_\_\_

*This batch manufacturing record must be completed in its entirety and approved by all designated reviewers before the device can proceed to electrical testing or further processing.*