

# BATCH MANUFACTURING RECORD

## STM Hydrogen Desorption Lithography Process

|                   |                      |                    |                      |
|-------------------|----------------------|--------------------|----------------------|
| Batch Number:     | <input type="text"/> | Date Started:      | <input type="text"/> |
| Device ID:        | <input type="text"/> | Target Completion: | <input type="text"/> |
| Sample:           | <input type="text"/> | Actual Completion: | <input type="text"/> |
| Primary Operator: | <input type="text"/> | QC Review:         | <input type="text"/> |

### Step 1: Ex Situ — New Sample Mounting

|                    |             |                          |           |                            |
|--------------------|-------------|--------------------------|-----------|----------------------------|
| Operator Initials: | Start Time: | 2025-11-11T12:48:00.000Z | End Time: | 2025-11-11T12:49:52.843789 |
|--------------------|-------------|--------------------------|-----------|----------------------------|

#### Process Parameters:

| Parameter                   | Specification | Actual Value         | Within Spec?   |
|-----------------------------|---------------|----------------------|--|
| Sample Plate Id             | As required   | <input type="text"/> | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Substrate Id                | As required   | <input type="text"/> | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Substrate Dopant            | As required   | <input type="text"/> | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Substrate Resistivity Ohmcm | As required   | <input type="text"/> | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Substrate Thickness Um      | As required   | <input type="text"/> | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Sample Alias                | As required   | <input type="text"/> | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Sample Id                   | As required   | <input type="text"/> | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Mount Resistance Kohm       | As required   | <input type="text"/> | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Notes                       | As required   | <input type="text"/> | <input type="checkbox"/> Yes <input type="checkbox"/> No |

#### Quality Checks:

| ✓                        | Check Description    | Pass/Fail   |
|--------------------------|----------------------|---|
| <input type="checkbox"/> | Sample secured       | <input type="checkbox"/> Pass <input type="checkbox"/> Fail |
| <input type="checkbox"/> | Contacts intact      | <input type="checkbox"/> Pass <input type="checkbox"/> Fail |
| <input type="checkbox"/> | Plate ID matches log | <input type="checkbox"/> Pass <input type="checkbox"/> Fail |

<b>Notes / Observations:</b>

Completed by:

Date/Time: 2025-11-11T12:49:52.843789

Verified by:

Date/Time:

## Step 2: Degassing

Operator Initials:

Start Time: 2025-11-11T12:45:12.370000

End Time: 2025-11-11T12:52:28.720680

### Process Parameters:

| Parameter                     | Specification | Actual Value | Within Spec? |
|-------------------------------|---------------|--------------|--------------|
| P Mbe Base Mbar               | As required   |              | ■ Yes ■ No   |
| Resistive Ramp Up Min         | As required   |              | ■ Yes ■ No   |
| Resistive Peak Pressure Mbar  | As required   |              | ■ Yes ■ No   |
| Resistive Peak Current A      | As required   |              | ■ Yes ■ No   |
| Resistive Peak Temperature C  | As required   |              | ■ Yes ■ No   |
| Resistive Ramp Down Min       | As required   |              | ■ Yes ■ No   |
| Direct Base Mbe Pressure Mbar | As required   |              | ■ Yes ■ No   |
| Direct Ramp Up Min            | As required   |              | ■ Yes ■ No   |
| Direct Peak Pressure Mbar     | As required   |              | ■ Yes ■ No   |
| Direct Peak Current A         | As required   |              | ■ Yes ■ No   |
| Direct Peak Temperature C     | As required   |              | ■ Yes ■ No   |
| Direct Ramp Down Min          | As required   |              | ■ Yes ■ No   |
| File Name                     | As required   |              | ■ Yes ■ No   |

### Quality Checks:

| ✓ | Check Description                     | Pass/Fail     |
|---|---------------------------------------|---------------|
| ■ | Target temperatures reached           | ■ Pass ■ Fail |
| ■ | Peak pressure within acceptable range | ■ Pass ■ Fail |

<b>Notes / Observations:</b>

Completed by:

Date/Time: 2025-11-11T12:52:28.720680

|                     |                   |
|---------------------|-------------------|
| <b>Verified by:</b> | <b>Date/Time:</b> |
|---------------------|-------------------|

### Step 3: Flashing

Operator Initials: Start Time: 2025-11-11T12:45:17.078545 End Time: 2025-11-11T12:57:17.078545

#### Process Parameters:

| Parameter           | Specification | Actual Value | Within Spec? |
|---------------------|---------------|--------------|--------------|
| Idle Temperature C  | As required   |              | ■ Yes ■ No   |
| Idle Current A      | As required   |              | ■ Yes ■ No   |
| Flash Temperature C | As required   |              | ■ Yes ■ No   |
| Flash Current A     | As required   |              | ■ Yes ■ No   |
| Cooldown Time Min   | As required   |              | ■ Yes ■ No   |
| Number Of Flashes   | As required   |              | ■ Yes ■ No   |
| File Name           | As required   |              | ■ Yes ■ No   |
| Flash Table         | As required   |              | ■ Yes ■ No   |

#### Quality Checks:

| ✓ | Check Description    | Pass/Fail     |
|---|----------------------|---------------|
| ■ | Flashes sufficient   | ■ Pass ■ Fail |
| ■ | No abnormal P spikes | ■ Pass ■ Fail |

<b>Notes / Observations:</b>

Completed by: Date/Time: 2025-11-11T12:57:17.078545  
Verified by: Date/Time:

### Step 4: Temperature Calibration (Cooldown analysis)

Operator Initials: Start Time: 2025-11-11T12:57:25.091032 End Time: 2025-11-11T13:10:25.091032

#### Process Parameters:

| Parameter         | Specification | Actual Value | Within Spec? |
|-------------------|---------------|--------------|--------------|
| Current At 335C A | As required   |              | ■ Yes ■ No   |
| Current At 350C A | As required   |              | ■ Yes ■ No   |
| Current At 470C A | As required   |              | ■ Yes ■ No   |
| Current At 250C A | As required   |              | ■ Yes ■ No   |

|                   |             |       |            |
|-------------------|-------------|-------|------------|
| Calibration File  | As required | _____ | ■ Yes ■ No |
| Calibration Notes | As required | _____ | ■ Yes ■ No |

**Quality Checks:**

| ✓ | Check Description           | Pass/Fail     |
|---|-----------------------------|---------------|
| ■ | Calibration points verified | ■ Pass ■ Fail |
| ■ | Matches prior runs          | ■ Pass ■ Fail |

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

|                      |  |
|----------------------|--|
| <b>Completed by:</b> | <b>Date/Time:</b> 2025-11-11T13:10:25.091032 |
| <b>Verified by:</b>  | <b>Date/Time:</b>                            |

## Step 5: Hydrogen Termination

Operator Initials: Start Time: 2025-11-11T12:45:12.370000 End Time: 2025-11-11T13:13:44.959654

### Process Parameters:

| Parameter                  | Specification | Actual Value | Within Spec?   |
|----------------------------|---------------|--------------|--|
| Termination Current A      | As required   |              | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Termination Temperature C  | As required   |              | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Termination Pressure Mbar  | As required   |              | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Peak Cracker Temperature C | As required   |              | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Peak Cracker Current A     | As required   |              | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Seven Step Table           | As required   |              | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| File Name                  | As required   |              | <input type="checkbox"/> Yes <input type="checkbox"/> No |

### Quality Checks:

| ✓                        | Check Description   | Pass/Fail   |
|--------------------------|---------------------|---|
| <input type="checkbox"/> | Cooling water on    | <input type="checkbox"/> Pass <input type="checkbox"/> Fail |
| <input type="checkbox"/> | Valves configured   | <input type="checkbox"/> Pass <input type="checkbox"/> Fail |
| <input type="checkbox"/> | P_MAX within spec   | <input type="checkbox"/> Pass <input type="checkbox"/> Fail |
| <input type="checkbox"/> | Uniform termination | <input type="checkbox"/> Pass <input type="checkbox"/> Fail |

<b>Notes / Observations:</b>

Completed by: Date/Time: 2025-11-11T13:13:44.959654

Verified by: Date/Time:

## Step 6: Termination Check (STM)

Operator Initials: Start Time: 2025-11-11T12:45:12.370000 End Time: 2025-11-11T13:23:53.730366

### Process Parameters:

| Parameter           | Specification | Actual Value | Within Spec?   |
|---------------------|---------------|--------------|--|
| Scan Area Nm        | As required   |              | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Bias Voltage V      | As required   |              | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Setpoint Current Pa | As required   |              | <input type="checkbox"/> Yes <input type="checkbox"/> No |

|                          |             |       |            |
|--------------------------|-------------|-------|------------|
| Scan Folder Location     | As required | _____ | ■ Yes ■ No |
| Scan Numbers Of Interest | As required | _____ | ■ Yes ■ No |
| Coverage Assessment      | As required | _____ | ■ Yes ■ No |
| File Name                | As required | _____ | ■ Yes ■ No |

**Quality Checks:**

| ✓ | Check Description  | Pass/Fail     |
|---|--------------------|---------------|
| ■ | Uniform H coverage | ■ Pass ■ Fail |
| ■ | No contamination   | ■ Pass ■ Fail |

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

**Completed by:**

**Date/Time:** 2025-11-11T13:23:53.730366

**Verified by:**

**Date/Time:**

## Step 7: STM HDL

**Operator Initials:** \_\_\_\_\_ **Start Time:** 2025-11-11T13:14:16.54100 **End Time:** 2025-11-11T13:14:49.184135

### Process Parameters:

| Parameter            | Specification | Actual Value | Within Spec? |
|----------------------|---------------|--------------|--------------|
| Fem Voltage V        | As required   | _____        | ■ Yes ■ No   |
| Fem Current Pa       | As required   | _____        | ■ Yes ■ No   |
| Fem Speed            | As required   | _____        | ■ Yes ■ No   |
| Apm Voltage V        | As required   | _____        | ■ Yes ■ No   |
| Apm Current Pa       | As required   | _____        | ■ Yes ■ No   |
| Apm Speed            | As required   | _____        | ■ Yes ■ No   |
| Fem Pitch            | As required   | _____        | ■ Yes ■ No   |
| Apm Pitch            | As required   | _____        | ■ Yes ■ No   |
| Passes               | As required   | _____        | ■ Yes ■ No   |
| Total Path Length Nm | As required   | _____        | ■ Yes ■ No   |
| File Name            | As required   | _____        | ■ Yes ■ No   |

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

**Completed by:** \_\_\_\_\_ **Date/Time:** 2025-11-11T13:14:49.184135

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

## Step 8: Dose (XH3)

**Operator Initials:** \_\_\_\_\_ **Start Time:** 2025-11-11T12:45:17.37100 **End Time:** 2025-11-11T13:17:45.364905

### Process Parameters:

| Parameter                 | Specification | Actual Value | Within Spec? |
|---------------------------|---------------|--------------|--------------|
| Dopant Species            | As required   | _____        | ■ Yes ■ No   |
| Target Dose Pressure Mbar | As required   | _____        | ■ Yes ■ No   |
| Dose Duration S           | As required   | _____        | ■ Yes ■ No   |
| Initial Pressure Mbar     | As required   | _____        | ■ Yes ■ No   |
| Mean Dose Pressure Mbar   | As required   | _____        | ■ Yes ■ No   |



|                            |             |       |            |
|----------------------------|-------------|-------|------------|
| Baseline Pressure Mbar     | As required | _____ | ■ Yes ■ No |
| Exposure Langmuirs         | As required | _____ | ■ Yes ■ No |
| Leak Valve Start Turns     | As required | _____ | ■ Yes ■ No |
| Leak Valve Operating Turns | As required | _____ | ■ Yes ■ No |
| Dose Start Time            | As required | _____ | ■ Yes ■ No |
| Dose End Time              | As required | _____ | ■ Yes ■ No |
| File Name                  | As required | _____ | ■ Yes ■ No |
| P Vt Channel Name          | As required | _____ | ■ Yes ■ No |

#### Quality Checks:

| ✓ | Check Description      | Pass/Fail     |
|---|------------------------|---------------|
| ■ | Tip retracted          | ■ Pass ■ Fail |
| ■ | Stage locked           | ■ Pass ■ Fail |
| ■ | Matrix controller off  | ■ Pass ■ Fail |
| ■ | Pressure stable (P_VT) | ■ Pass ■ Fail |

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

|                      |  |
|----------------------|--|
| <b>Completed by:</b> | <b>Date/Time:</b> 2025-11-11T13:17:45.364905 |
| <b>Verified by:</b>  | <b>Date/Time:</b>                            |

## Step 9: Incorporation

Operator Initials: Start Time: 2025-11-11T12:45:12.378000 End Time: 2025-11-11T13:19:17.189630

### Process Parameters:

| Parameter                   | Specification | Actual Value | Within Spec?   |
|-----------------------------|---------------|--------------|--|
| Incorporation Temperature C | As required   |              | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Incorporation Time S        | As required   |              | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Planned Current A           | As required   |              | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Actual Current A            | As required   |              | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Initial Pressure Mbar       | As required   |              | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Max Pressure Mbar           | As required   |              | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Incorporation Location      | As required   |              | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| File Name                   | As required   |              | <input type="checkbox"/> Yes <input type="checkbox"/> No |

### Quality Checks:

| ✓                        | Check Description           | Pass/Fail   |
|--------------------------|-----------------------------|---|
| <input type="checkbox"/> | 350C ± 5C                   | <input type="checkbox"/> Pass <input type="checkbox"/> Fail |
| <input type="checkbox"/> | 2 min strict                | <input type="checkbox"/> Pass <input type="checkbox"/> Fail |
| <input type="checkbox"/> | Pressure acceptable (P_MBE) | <input type="checkbox"/> Pass <input type="checkbox"/> Fail |

<b>Notes / Observations:</b>

Completed by: Date/Time: 2025-11-11T13:19:17.189630

Verified by: Date/Time:

## Step 10: Overgrowth (LL + RTA + LTE)

Operator Initials: Start Time: 2025-11-11T12:45:12.378000 End Time: 2025-11-11T13:23:35.973890

### Process Parameters:

| Parameter                    | Specification | Actual Value | Within Spec?   |
|------------------------------|---------------|--------------|--|
| Total Overgrowth Nm          | As required   |              | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Total Growth Time S          | As required   |              | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Susi Calibration Rate Nm Min | As required   |              | <input type="checkbox"/> Yes <input type="checkbox"/> No |

|                            |             |       |            |
|----------------------------|-------------|-------|------------|
| Susi Calibration Current A | As required | _____ | ■ Yes ■ No |
| Susi Calibration Date      | As required | _____ | ■ Yes ■ No |
| Li Time S                  | As required | _____ | ■ Yes ■ No |
| Li Current A               | As required | _____ | ■ Yes ■ No |
| Li Temperature C           | As required | _____ | ■ Yes ■ No |
| Rta Temperature C          | As required | _____ | ■ Yes ■ No |
| Rta Time S                 | As required | _____ | ■ Yes ■ No |
| Rta Current A              | As required | _____ | ■ Yes ■ No |
| Lte Time S                 | As required | _____ | ■ Yes ■ No |
| Lte Current A              | As required | _____ | ■ Yes ■ No |
| Lte Temperature C          | As required | _____ | ■ Yes ■ No |
| Lte Deposited Nm           | As required | _____ | ■ Yes ■ No |
| Preheat Required           | As required | _____ | ■ Yes ■ No |
| Preheat Time S             | As required | _____ | ■ Yes ■ No |
| Preheat Max Current A      | As required | _____ | ■ Yes ■ No |
| Preheat Max Pressure Mbar  | As required | _____ | ■ Yes ■ No |
| Sample Location            | As required | _____ | ■ Yes ■ No |
| Overgrowth Events Table    | As required | _____ | ■ Yes ■ No |
| File Name                  | As required | _____ | ■ Yes ■ No |

#### Quality Checks:

| ✓ | Check Description          | Pass/Fail     |
|---|----------------------------|---------------|
| ■ | Cooling on and pumping     | ■ Pass ■ Fail |
| ■ | Position/angle verified    | ■ Pass ■ Fail |
| ■ | Shutter operations correct | ■ Pass ■ Fail |

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

**Completed by:**

**Date/Time:** 2025-11-11T13:23:35.973890

**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.*