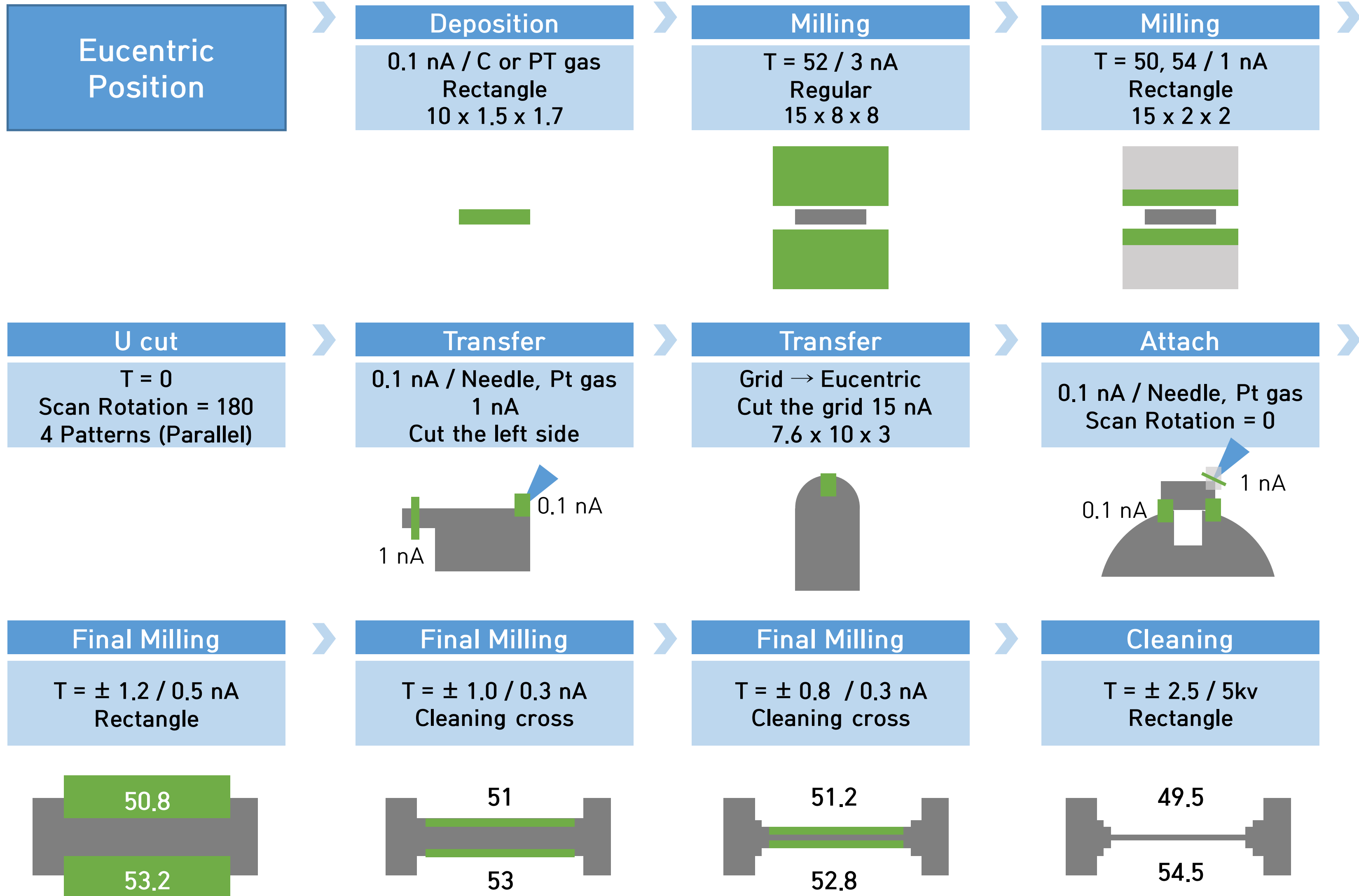
Training Material Number :  Author :  Date :

ULSAN NATIONAL INSTITUTE OF SCIENCE AND TECHNOLOGY

# Dual Beam FIB
## (Focused Ion Beam)

### FIB Operation Training Course

# Summary



# Milling (T = 52)

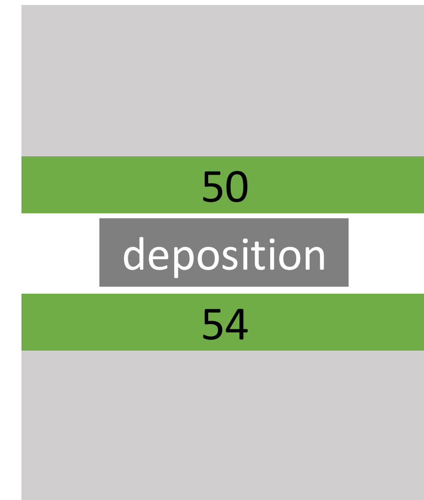
1) Change to Current 3.0 nA (Current adjustment according to the hardness of the sample)
2) Click 'ION' → Same as SEM magnification → Snap Shot
3) Regular cross section → Drag on the ION screen (Align with the bottom line of Deposition)
   Application : Si (Yellow) → X=15, Y=8, Z=8 (Adjust the Z according to the sample size)
4) 'ION' Snap shot → Play → Click 'SEM' → Snap shot → Check the milling position (drift)
5) Pattern click→ Advanced → rotation 180 → Move the pattern (Align with the top line of Deposition) → Play (depth가 5 um 이상이면 멈추기)

# Milling (T = 54, 50)



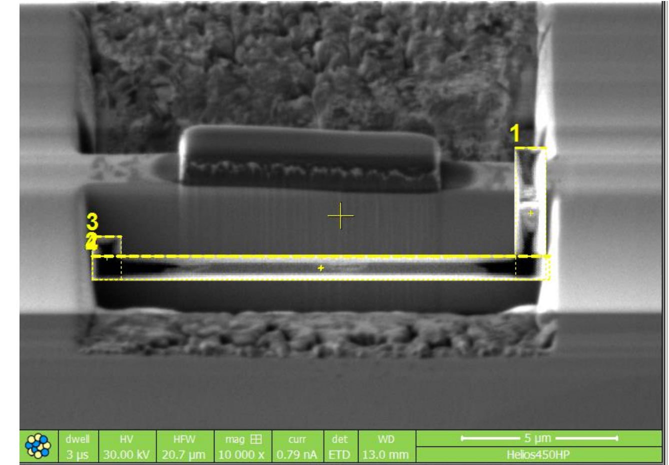
1) T = 54 → Click 'ION' → One level lower than Milling Current → Snap shot
2) Insert Pattern → ▼ → Click 'Rectangle' → Drag on the ION screen
3) Pattern Application : Si, X = 15 um, Y = 2 um, Z = 2 um
4) Move the pattern (Align with the bottom line of Deposition) → ION Snap shot → Play
5) SEM snap shot → Check the milling position

1) T = 50 → Click 'ION' → Don't change Current → Snap shot
2) Click Pattern → Advanced → Rotation 180
3) Move the pattern (Align with the top line of Deposition) → Play

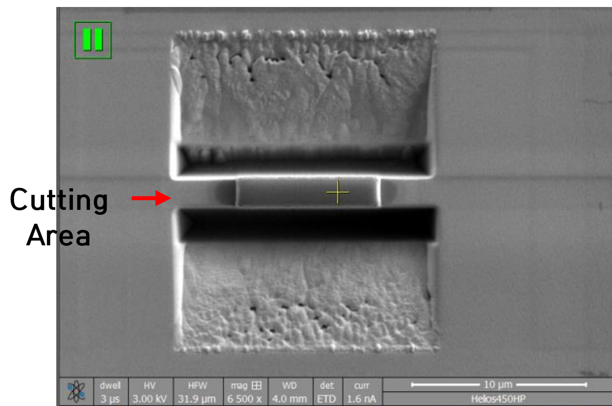


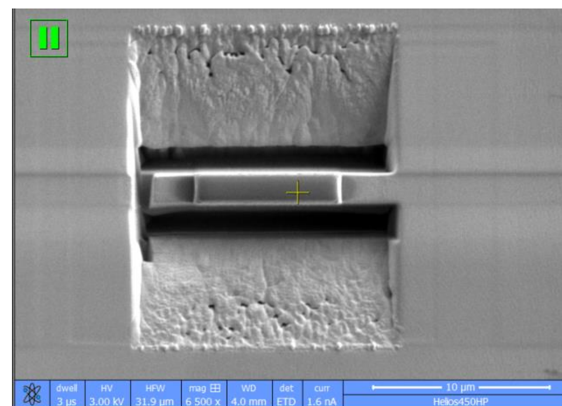
# Milling (T = 0)

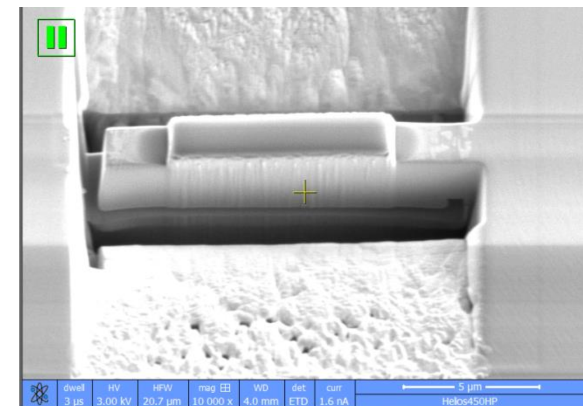
1) T = 0
2) Click 'ION' → Scan rotation (Shift + F12 → Click '180')
3) U cut : Draw 4 Rectangle pattern
4) Parallel → Z = 5 → Snap shot → Play
5) Check the cutting area on SEN screen
6) Click the STOP button as soon as it is cut ★
7) T = 17 → Check the bottom is cut off → T = 0




Cutting Area

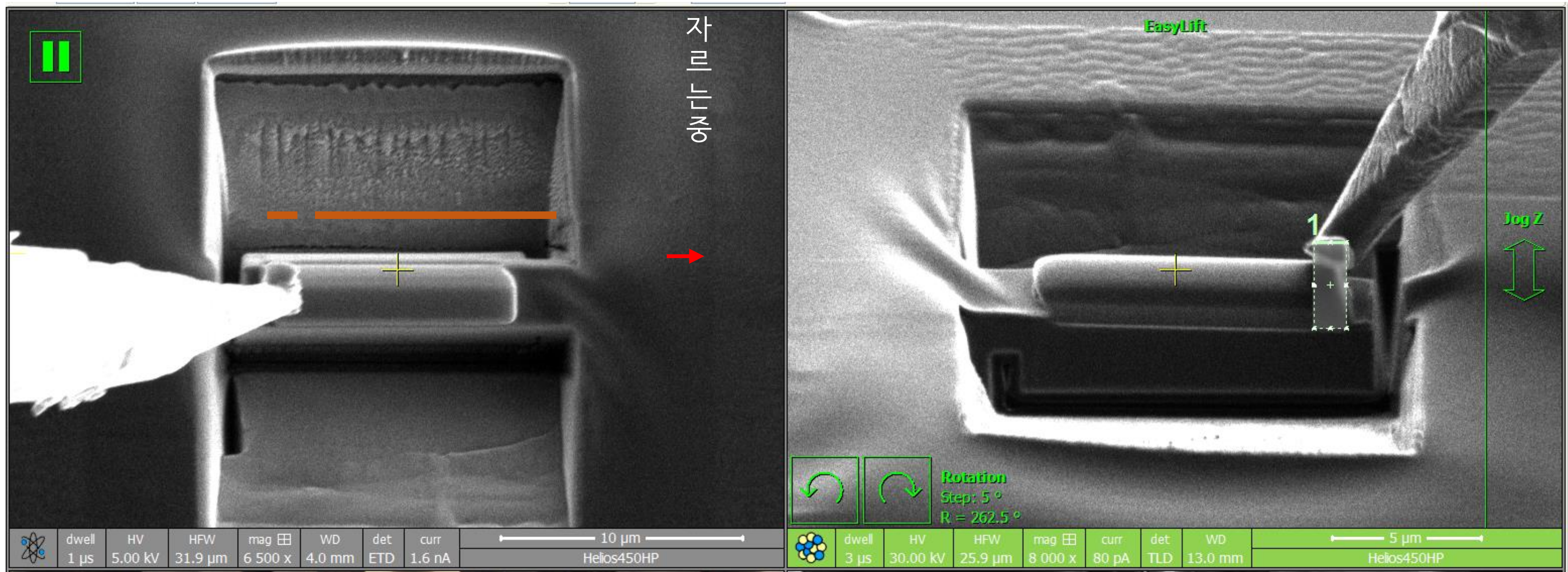


# Transfer

1) Click → 50pA → Click Insert Omniprobe → Insert PT gas
2) ION 창 : Live → Z - 를 눌러서 화면에 프로브 끝이 보이도록 살짝 내리기
3) ION 창 : Z-랑 Y+를 눌러서 화면 중간으로 가져오기
4) SEM 창: X로 샘플라인에 맞추기
5) ION 창 : Y- 와 Z- 를 번갈아가며 눌러서 프로브 아래로 내리기 (중간중간 SEM 화면에서 X 위치 확인하기)
6) ION 창 : Snap Shot → Rectangle 패턴 삽입 → PT 선택 → Z = 1 → Play
7) 스테이지 내리기(오른쪽 아래 창 클릭 후 마우스 중간 버튼) → 니들 빼기



# Transfer

1) Move to grid
2) Align Eucentric position : Beam shift zero → Focusing→ Link Z = 10 → T = 52 → Move the stage (Click mouse middle button) → T = 0
3) Current 15nA → ION snap shot → Rectangle Pattern → X = 7.6 um, Y = 10, Z = 2 → Move the pattern → Play

Start Patterning in Quad 2

Make sure to same height

Pattern

1 -Rectangle 1

Basic | Advanced | Progress | Sel. Mill | EasyLift

| Name | Value |
|---|---|
| Application | Si New |
| X size | 7.60 µm |
| Y size | 10.00 µm |
| Z size | 2.20 µm |
| ScanDirection | Bottom To Top |
| DwellTime | 1.000 µs |
| Beam | Ion |
| Time | 0:01:00 |
| Beam Current | 10.43 nA |

Progress
Total Time: 0:01:00
Overall Progress
Current Progress

Select All

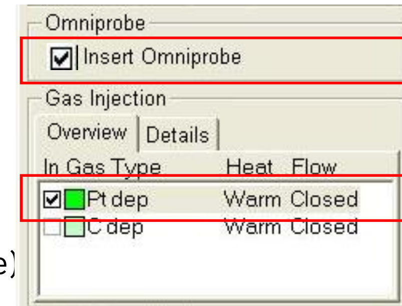
MultiChem Gas Injection

Patterning

| dwell | HV | HFW | mag | curr | det | WD | 20 µm |
|---|---|---|---|---|---|---|---|
| 3 µs | 30.00 kV | 59.2 µm | 3 500 x | 9.3 nA | TLD | 13.0 mm | Helios450HP |

# Transfer

1) Current 50 pA → Insert Needle→ PT gas
2) Align Grid and Sample position (SEM과 ION 창 모두 잘 확인하기)
3) Add 2 Rectangle Pattern on the ION screen→ Z=1 → Parallel → Play
4) Current 1.0 nA → erase the past pattern → Insert new pattern (Rectangle) → Si (Z = 5) → STOP when the dep is cut
5) Down the stage(Click right lower screen → mouse middle button) → retract gas




② Insert Needle, gas
⑥ Retract Needle, gas

① 50pA

③ 위치 맞추기

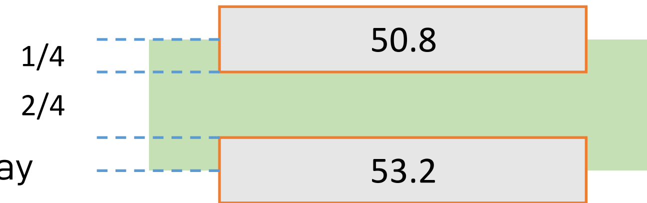
⑤ 니들 자르기

그리드에 붙이기

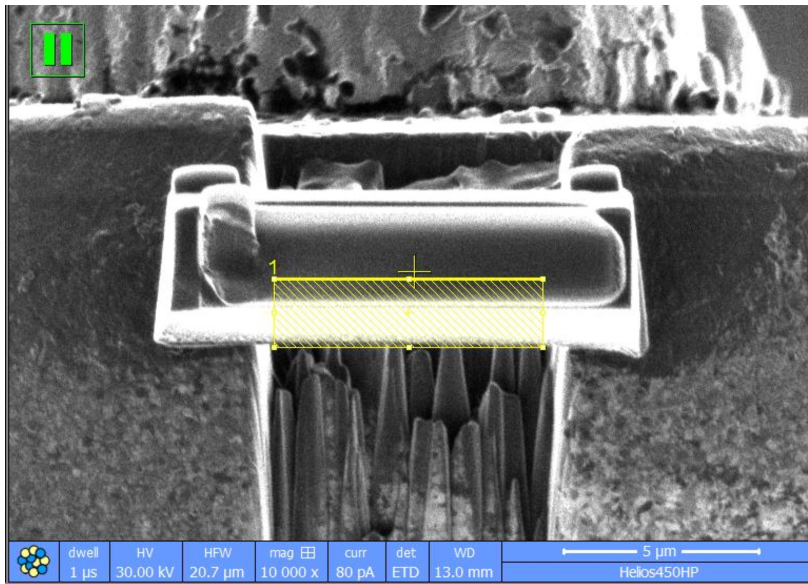
④

# Final milling (Step 1)

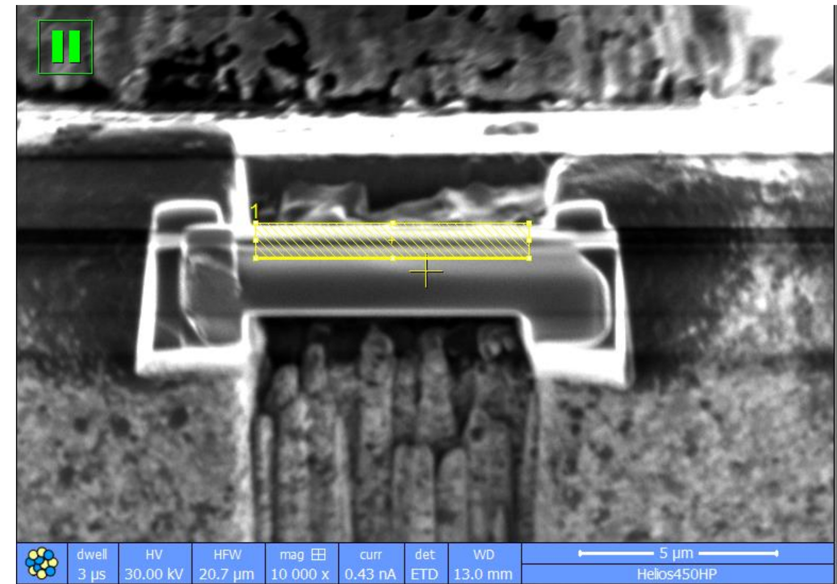
1) Scan rotation = 0 → 0.5 nA
2) Front (+ 1.2) : T = 53.2 → Rectangle → Z = 5 → Play
3) Back (- 1.2) : T = 50.8 → Advanced → rotation 180 → Play




Front (52 + 1.2) : T = 53.2

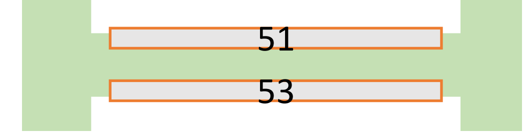



Back (52 - 1.2) : T = 50.8

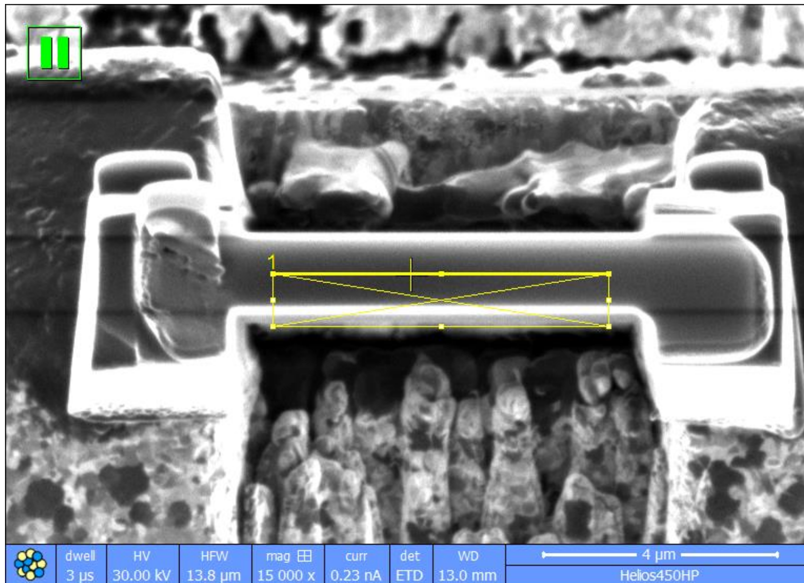


# Final milling (Step 2)

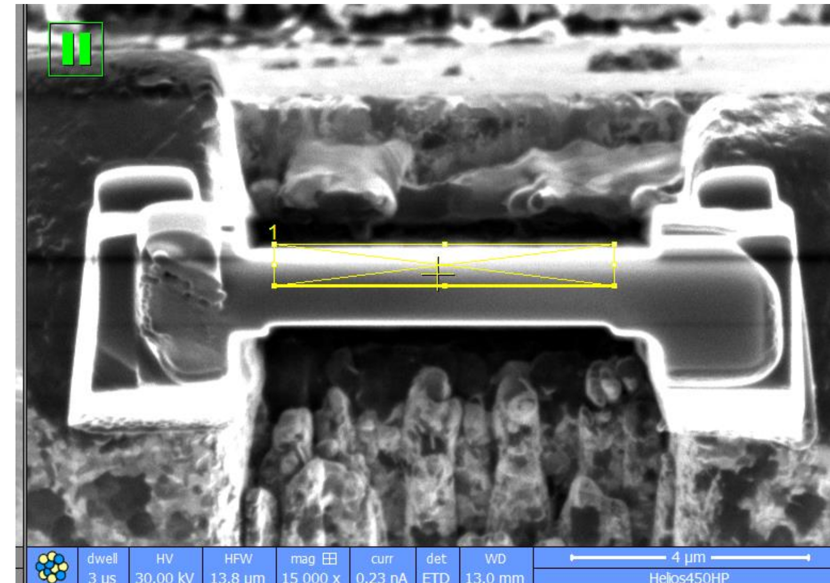
1) 0.3 nA
2) Front (+ 1) : T = 53 → Cleaning Cross Section → Z = 6 → Play
3) Back (- 1) : T = 51 → Advanced → Rotation 180 → Play




Front (52 + 1) : T = 53

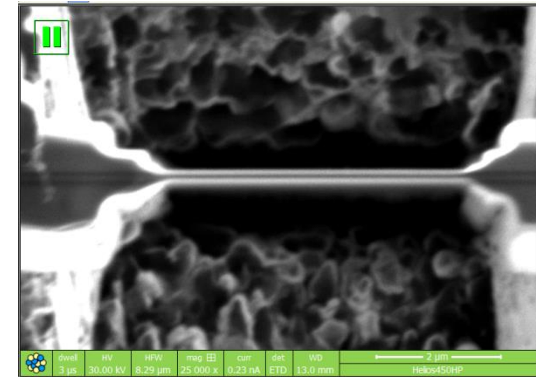



Back (52 - 1) : T = 51

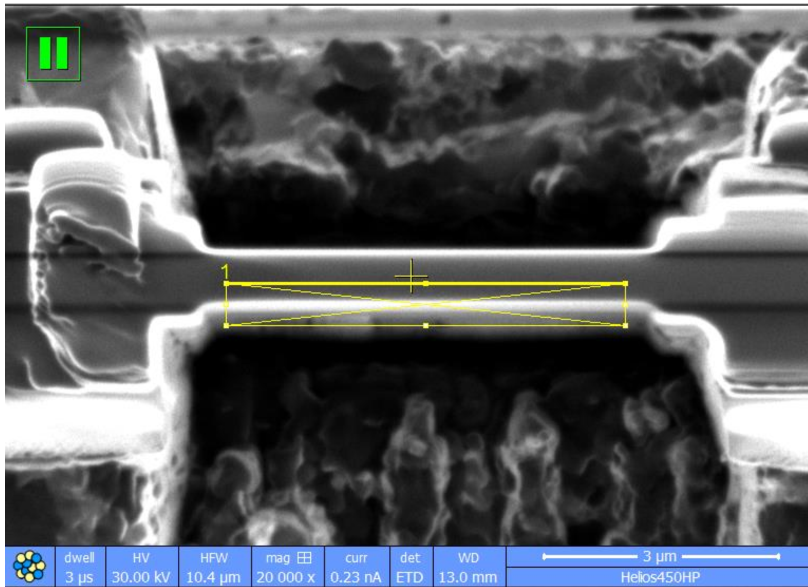


# Final milling (Step 3)

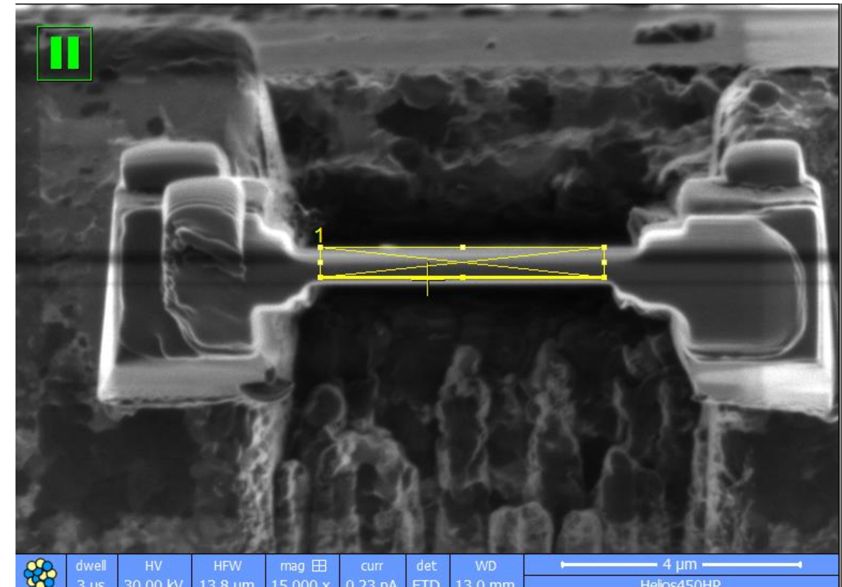
1) Front (+ 0.8) : T = 52.8 → Cleaning Cross Section → Play
2) Back (- 0.8) : T = 51.2 → Advanced → Rotation 180 → Play → Cut one line and pause → snap shot to SEM and ION → Check if occur banding and moving sample




Front (52 + 0.8) : T = 52.8



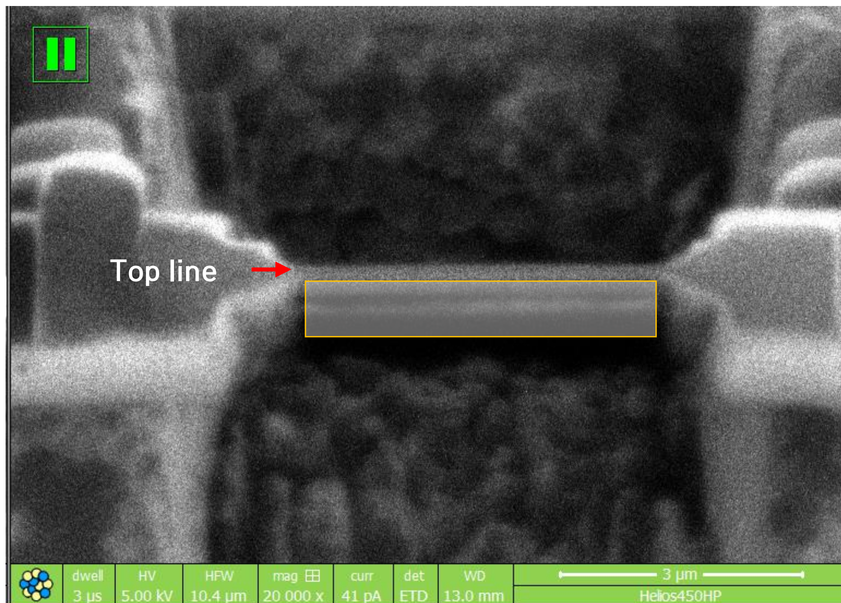

Back (52 - 0.8) : T = 51.2



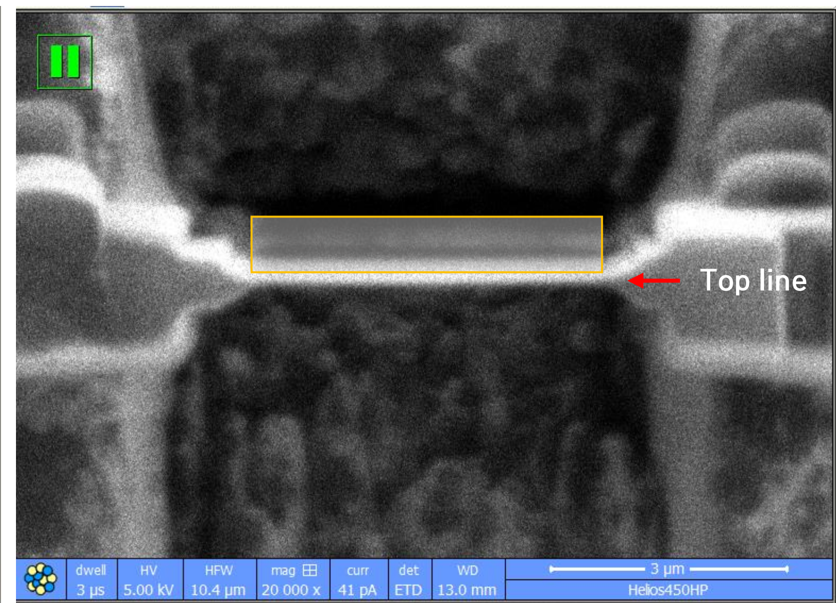
# Cleaning (5kv)

1) ION 5kv (68 or 41 pA), Apply to the front and back sides 5 times for 30 seconds each
2) Front : T = 54.5 → Rectangle → Positioned slightly down so as not to include the Top line → Play
3) Back : T = 49.5 → Advanced → Rotation 180 → Positioned slightly up so as not to include the Top line → Play

Front (52 + 2.5) : T = 54.5



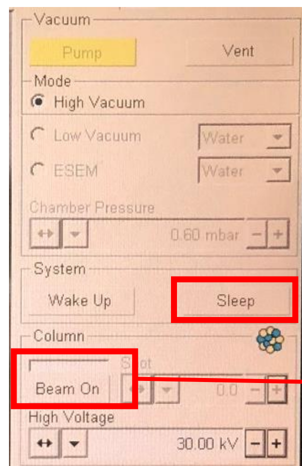

Back (52 - 2.5) : T = 49.5



# Final Check

1) T = 0
2) SEM and ION 'Baem off' (OFF state when the yellow light of the 'bean button' is off)
3) Delete 'pattern'
4) Beam Shift 'Zero'
5) X, Y = 0
6) Scan rotation = 0
7) ★ Check a next user ★

If you are the last user of the day : Click 'Sleep' button




When the Sleep button is pressed, the beam on bar in the Ion window changes to an empty state.

# Approve the result

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- Approve the result within 3 days of using the equipment
- Fill in the time spent on the BASIC FEE and the FIB.
- Based on 100% billing rate, 200,000 won per hour
- No change in billing rate
- Fill in the number of samples in the cross section field

사용비용

| 비용 | 단위수량 | 부과단위 | 단위금액 | 할인적용 | 옵션적용 | 사용수량 | 사용금액 | 청구율 | 할인율적용금액 |
|---|---|---|---|---|---|---|---|---|---|
| 기본공정료 | 0.5 | H | 30,000 | ☑ | | 1.0 | 60,000 | 50% | 30,000 |
| FIB | 0.5 | H | 70,000 | ☑ | | 1.0 | 140,000 | 50% | 70,000 |
| Grid | 1.0 | EA | 10,000 | ☐ | | | 0 | 100% | 0 |
| 합계 | | | | | | | 200,000 | | 100,000 |

☐ 사용료 면제 가동시간: 1.0 준비시간:

Sub장비 ○ 사용 ◉ 미사용

공정조건

| Cross section | | TEM sampling | | EBSD | |
|---|---|---|---|---|---|